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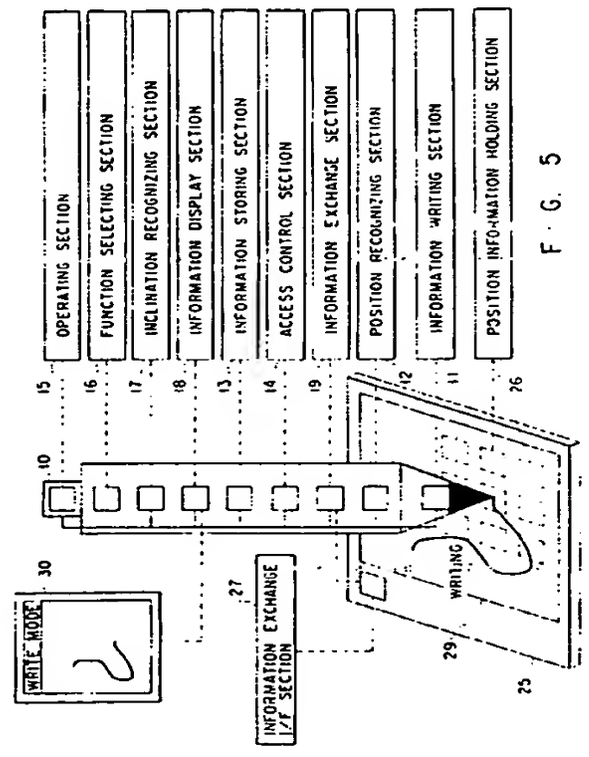
(71) Applicant : **Kabushiki Kaisha Toshiba**
72, Horikawa-cho
Saiwai-ku
Kawasaki-shi (JP)

(72) Inventor : **Morishita, Akira, c/o Intellectual Property Div.**
Kabushiki Kaisha Toshiba,
1-1 Shibaura 1-chome
Minato-ku, Tokyo 105 (JP)
Inventor : **Mizoguchi, Hiroshi, c/o Intellectual Property Div.**
Kabushiki Kaisha Toshiba,
1-1 Shibaura 1-chome
Minato-ku, Tokyo 105 (JP)

(74) Representative : **Waldren, Robin Michael et al**
MARKS & CLERK,
57-60 Lincoln's Inn Fields
London WC2A 3LS (GB)

(54) Information input device, position information holding device, and position recognizing system including them.

(57) An information input device according to the inven- tion is characterized by comprising information writing section (11) for writing information on a writing medium, position recognizing section (12) for recognizing a position of the information writing section (11) on the writing medium, and information storing section (13) for storing information obtained from the position recognizing section (12).



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In order to allow a flexible, natural information input operation for a user, tablets having required information input areas and input resolutions must be selectively used in correspondence with situations. For this reason, it is preferable that various tablets be present everywhere, or a user carry various tablets. In this case, a reduction in cost of tablets and downsizing of tablets pose a problem.

As described above, in the conventional information input device, the information input device and the tablet must be integrated, and it is hard to realize an information input device having various input areas. Furthermore, when information is input using the pen-type pointing device, the input information must be displayed at the input position of the pointing device. Therefore, in the conventional information input device, since the input device, the display device, and the tablet must be integrated, it is difficult to realize an information input device having various input areas.

Therefore, paper and pens are used as normal portable information input media. An information input method using a paper sheet and a pen is natural to a user. On the other hand, an information input operation using a conventional computer makes a user conscious of the use of an electronic device, and handiness equivalent to that of an information input operation using a paper sheet and a pen is hardly realized.

In an information input operation using a paper sheet, a pen, an eraser, and the like, various operations are attained by using tools themselves, and such an operation is natural to a user in terms of explicitness of an operation. However, since various input operations and function selecting operations in an information input operation of a conventional computer are attained in accordance with a menu displayed on the display device, they have poor explicitness of an operation.

When a paper sheet and a pen are frequently used as information input media, it is required to input information written on the paper sheet to a computer. At this time, it is preferable that an information input operation to a computer be easily performed.

Conventionally, in order to input information recorded on a paper sheet to a computer, a scanning input device such as an image scanner must be used. The image scanner is large in size, requires cumbersome input operations, and is normally shared by a plurality of users. Therefore, it is hard to say that satisfactory conventional information input means is realized.

As described above, in the conventional information input device, the portability is limited by the sizes of the display device and the position recognizing device. When the display device and the position recognizing device are rendered compact, an inputtable information size is reduced, or a cumbersome input operation is required. In addition, when a high-resolution information input operation is to be realized, a high-resolution display device is required, resulting in high cost of the device itself. Furthermore, since various input operations and function selecting operations in the information input device are performed in accordance with a menu on the display device, the information input device has poor explicitness of an operation.

When information recorded on a paper sheet is input to a computer, an image scanner or the like must be used. However, since the image scanner is large in size, requires cumbersome operations, and is normally shared by a plurality of users, it is difficult to achieve an easy input operation.

As described above, since the conventional information input device makes a user conscious of the use of an electronic device, a satisfactory information input method can hardly be provided.

It is an object of the present invention to provide an information input device which has high portability and a wide information display screen and information input surface, allows an input operation and a function selecting operation having explicitness, and allows a natural information input operation by naturally coupling a paper sheet and the information input device.

More specifically, it is an object of the present invention to provide an information input device with high portability, in which information is input at an instance when information is written on a paper sheet as a display device with high portability.

The arrangement of the overall information input device according to the present invention will be briefly described below. That is, as shown in FIG. 5, an information input device 10 comprises an information writing section 11 for writing information on a writing medium, a position recognizing section 12 for obtaining the absolute position of the information writing section 11 on the writing medium, an information storing section 13 for storing information from the position recognizing section 12, the state of the information input device 10, and the like, a function selecting section 16 for selecting a function to be executed in accordance with an operation to the device or the inclination state of the device, and executing the selected function, and an access control section 14 for controlling accesses to the information storing section in accordance with the selected function.

The information input device also comprises an operating section 15, including buttons, switches, and the like, for detecting a mechanical operation, and supplying a detection signal to the function selecting section, or an inclination recognizing section 17 for recognizing the inclination state of the device itself, and supplying a recognition signal to the function selecting section 16. The device may also comprise an information display section 18 for displaying a selected function or a written image, and an infor-

ke shape information input device and a planar position information holding device, is characterized in that the position information holding device includes position information holding section for holding a plurality of position information, and the information input device includes: section for detecting a position information, which is held by the information holding device, specified by a pen tip of the information input device; section for obtaining an absolute position of the pen tip on the planar position information holding device according to a detected position information; and section for storing the obtained absolute position as a trace information of the pen tip.

The plurality of position information include different position information from each other. The plurality of position information further include a plurality set position information, which includes a predetermined number of the position information and is different from each other.

An information input device is characterized by further comprising display device for displaying motion state of the information input device and writing information.

The information input device further includes information exchange section for transmitting/receiving writing information among a plurality of the information input devices, and the position information holding device further includes interface section for connecting a plurality of the information exchange section of the information input devices.

The position information holding device includes section for differentiating combinations of adjacent position information in entire position information holding device.

According to the present invention, since the information writing section 11 allows a writing medium such as a paper sheet to be used as an information display screen, it can provide an information display screen which is not limited by the size of the information input device 10 to a user. At the same time, the position recognizing section 12 can realize an information input region which is not limited by the size of the information input device 10. Thus, the information input device 10 which has a wide information display screen and information input region, and high portability can be provided. When the information input device 10 is used together with the tablet-type position information holding device 25 as an external device, the size and cost of the position information holding device 25 can be reduced. Thus, a portable information input system having various information input regions can be provided.

Information written on a writing medium can be input to the information input device 10 by the information storing section for storing information from the position recognizing section 12, and the access control section for controlling the information storing section.

An information input operation with explicitness can be attained by the function selecting section for selecting a function to be executed in accordance with an operation to the information input device or the inclination state of the information input device, and executing the selected information, the operating section 15 for detecting a mechanical operation, and supplying a detection signal to the function selecting section, the inclination recognizing section for recognizing the inclination state of the device itself, and supplying a recognition signal to the function selecting section, and the information display section for explicitly displaying the selected function or the operating state of the device. Therefore, according to the present invention, the information input device 10, which can perform an information input operation with explicitness, can be provided.

According to the present invention, the information input device which can automatically store information normally written on a paper sheet, and has high operability and portability, and the position information holding device can be provided, and the position recognizing system which can easily and effectively recognize the position upon input of information can also be provided.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view showing a conventional lap-top computer;

FIG. 2 is a perspective view showing a conventional pen-input type computer;

FIGS. 3 and 4 are schematic views showing conventional tablets;

FIG. 5 is a diagram showing the concept of the overall device according to an embodiment of the present invention;

FIG. 6 is a schematic diagram showing the arrangement of a position recognizing system including an information input device and a position information holding device according to an embodiment of the present invention;

FIGS. 7A and 7B are perspective views for explaining a first position recognizing method using the information input device and the position information holding device according to the present invention;

FIG. 8 is a view for explaining a second position recognizing method using the information input device according to the present invention;

FIG. 9 is a view for explaining a third position recognizing method using the information input device according to the present invention, and a conventional tablet;

FIG. 10 is a diagram for explaining the flow of operations in the information input device according to the present invention;

FIGS. 11A and 11B are views showing an exam-

FIG. 54 is a view showing the arrangement adopted when the position of an information writing section of the present invention is digitally recognized;

FIGS. 55A to 55C are views showing other arrangements of FIG. 54; and

FIGS. 56A to 56D are views showing other arrangements of FIG. 54.

An embodiment of the present invention will be described below with reference to the accompanying drawings.

FIG. 6 shows the schematic arrangement of a position recognizing system including an information input device and a position information holding device according to an embodiment of the present invention. In FIG. 6, dotted arrows indicate the flows of signals.

An information input device 10 for inputting writing information (or position information) comprises an information writing section 11, a position recognizing section 12, an information storing section 13, an access control section 14, at least one operating section 15, a function selecting section 16, an inclination recognizing section 17, an information display section 18, and an information exchange section 19.

A position information holding device 25 is a tablet-type auxiliary device for the information input device 10, and comprises a plurality of position information holding sections 26 and an information exchange I/F section 27 (in the following description, an interface will be abbreviated as I/F). When the position information holding device 25 and the information input device 10 are used together, a position recognizing system with high precision can be realized. A writing medium 29 (e.g., a paper sheet) is placed on the surface of the position information holding device 25. The information input device 10 recognizes a written image (writing position) with high precision by writing information on the writing medium 29. Since the position information holding device 25 comprises the information exchange I/F section 27, connected to the information exchange section of the at least one information input device 10, for exchanging information between the information input device 10 and the position information holding device 25, the device 25 can also be used as an auxiliary device for performing an easy information operation between a plurality of information input devices 10.

A writing information display device 30 is a compact display device capable of performing a high-definition display operation. The writing information display device 30 has a plurality of display points, and has a function of storing display information at each display point, and a function of receiving image information such as new writing information written by the information input device 10, the operating state of the information input device 10, and the like. The writing information display device 30 is an auxiliary device for allowing easy understanding of information input by a user by displaying a high-definition reduction-scale image of an image written on a paper sheet, a function selected by the information input device 10, the operating state of the information input device 10, and the like.

The information writing section 11 constructs a pen tip 60 of the information input device 10 (information writing device is also referred to as a pen tip hereinafter), and has a function of detecting position information of the position information holding sections 26. The information writing section 11 may further have a function of writing information on a writing medium 29. The information writing section 11 also includes a switch (not shown) for starting a reading operation of position information.

The position recognizing section 12 obtains the position of the pen tip 60 (i.e., the information writing section 11) of the information input device 10. When the information input device 10 and the position information holding device 25 are used together, the position recognizing section 12 obtains the absolute position on a writing medium on the basis of position information detected based on each position information holding section 26.

The information storing section 13 stores writing information, information associated with the state of the device, and the like.

The access control section 14 controls the information storing section 13. More specifically, the access control section 14 stores position information obtained (or recognized) by the position recognizing section 12 in the information storing section 13 in accordance with a function in execution or the operating state of the information input device 10, and retrieves and accesses writing information, which is placed on portions of the position information corresponding to obtained (or recognized) information on the basis of position information obtained (or recognized) by the position recognizing section 12, of writing information stored in the information storing section 13.

The operating section 15 detects an operation designated by a user to the information input device 10, and outputs the detected operation information to the function selecting section 16.

The function selecting section 16 executes a predetermined function on the basis of operation information from the operating section 15 and the inclination state of the information input device 10, and manages the function in execution, and information such as the inclination state of the information input device 10.

The inclination recognizing section 17 recognizes the inclination state of the information input device 10, and outputs the inclination information of the information input device 10 to the function selecting section 16.

The information display section 18 displays a function in execution and the operating state of the in-

The position information of the pen tip 60 recognized by the position recognizing section 12 is output to the access control section 14. The function selecting section 16 requests the access control section 14 to process the position information on the basis of a function in execution, and the inclination or motion state of the information input device 10. The access control section 14 requests the information storing section 13 to store the position information.

As described above, when position recognition is performed by the method shown in FIG. 7B or 9, a paper sheet is placed on the position information holding device 25 or the tablet, and the pen tip 60 comprises normal writing means, so that information written on the paper sheet can be automatically stored. When position recognition is performed by the method shown in FIG. 8, the same recognition processing as described above can be attained by only the information input device 10.

FIG. 10 is a view for explaining the flow of the operations in the information input device 10 of the present invention.

The pen tip 60 which can write information on a paper sheet incorporates the information writing section 11, and a switch (not shown) for operating the information writing section 11. When the pen tip 60 is pressed against the position information holding device 25, detection of the position information of each position information holding section 26 is started.

When a paper sheet is fixed to the position information holding device 25, and information is written on the paper sheet with the pen tip 60, the position information of the pen tip 60 detected by the information writing section 11 is output to the access control section 14 via the position recognizing section 12. On the other hand, a time recognizing section 20 outputs the writing time of each point to the access control section 14 in synchronism with the output of the position information from the information writing section 11 to the access control section 14. The access control section 14 stores the position information from the position recognizing unit 12 and the time information from the time recognizing section 20 as one pair of information in the information storing section 13.

FIGS. 11A and 11B are views showing an example of recording of a written image by the information input device 10 of the present invention. FIG. 11A shows character information written on the position information holding sections 26. FIG. 11B shows the positions of the position information holding sections 26 corresponding to the character information shown in FIG. 11A, and hatched portions represent the position information of the position information holding sections 26 corresponding to the character information shown in FIG. 11A.

When a letter "a" is written on a paper sheet fixed on the position information holding sections 26, a position information string corresponding to the position information of the position information holding sections 26 below the written points is recorded in the order of written strokes. For example, when a letter "a" is written, stroke information corresponds to a position information string in the order of (21, 20, 28, 27,..., 55).

FIGS. 12 and 13 show an embodiment associated with stored data of a written image by the information input device 10 of the present invention. FIG. 12 shows the types of stored codes of a written image, and FIG. 13 shows stored information of the written image.

Referring to FIG. 12, the position information of each point in the position information string shown in FIG. 11B is paired with the writing time of the corresponding point, and constitutes one writing information code (position information, writing time). For example, for a point written at position "21" at time "0000", a writing information code (21, 0000) is generated. When one writing stroke ends, and the pen tip 60 is released from a paper sheet, a special information code (to be referred to as an "end code" hereinafter) (-1, -1) indicating the end of one writing stroke is added to the end of a stroke information code string. With this end code, each stroke information is stored to be distinguished from other information.

As shown in FIG. 13, a writing attribute code (string) is inserted in a writing information code (string) so as to discriminate a writing attribute such as a writing width, a writing density, and the like. The writing attribute is changed by performing a specific operation to the operating section 15 by a user when the pen tip 60 is separated from a paper sheet. The writing attribute code is distinguished from a normal writing information code since it starts with a special information code (-2, -2). The contents of the writing attribute include attribute information such as a line width, density, and the like, which are required when a written image is reproduced by a display. In this case, for example, attribute information of the density consists of a color conversion code used for reproducing an image on a multi-color display, and a dither conversion code used for reproducing an image on a monochrome display. The end of the writing attribute code is identified by an end code (-1, -1) like in the writing information code.

An image written on a paper sheet is converted into the above-mentioned codes, and these codes are recorded in the information storing section 13.

FIGS. 14 to 16 show the mechanism for detecting the position information of each position information holding section 26 by the information input device 10 of the present invention.

The size of each point which records position information on the position information holding device 25 is about 0.1 mm if the resolution is 300 dpi. For this reason, the size of a head for detecting position information of one point often becomes smaller than the

the information writing section 11 of the information input device 10 or a rotation operation to the pen tip 60 thereof.

The information writing section 11 has a second push button switch 39 which allow a push operation and the pen tip 60 has a third rotary switch 37 which allow a rotation operation. When each of the third rotary switch 37 and the second push button switch 39 is operated, the corresponding operation information is output to the function selecting section 16 via the operating section 15c or 15e.

When the third rotary switch 37 is operated (i.e., the pen tip 60 is simply rotated), the control code selecting section 40 selects a control code for changing the line width, and requests the third control code executing section 43 to execute the selected control code. The third control code executing section 43 changes the writing attribute associated with the line width of a subsequently written image to the designated line width code.

When the third rotary switch 37 and the second push button switch 39 are simultaneously operated (i.e., the pen tip 60 is rotated while the information writing section 11 is pushed), the control code selecting section 40 selects a control code for changing the line density, and requests a fifth control code executing section 45 to execute the selected code. The fifth control code executing section 45 changes the writing attribute associated with the density of a subsequently written image to the designated density code.

FIGS. 21A and 21B are views showing an example of the function selecting operation, i.e., a menu selecting method.

In FIG. 20, when the control code for changing the line width is executed, the first display 18b displays a message "lead being changed". When the third rotary switch 37 is rotated in the direction of an arrow in FIG. 21A, line density information displayed on the second display 18 scrolls upon operation of the third rotary switch 37, as shown in FIG. 21B, so that one of various line densities can be selected. When a required line density is displayed on the second display 18c, a new line density is selected by, e.g., double-clicking a first push button switch 38.

FIG. 22 shows the operations of the access control section 14 and the information storing section 13. The access control section 14 holds a memory managing table 50 consisting of address information for managing writing information, and performing various memory operations. In this case, a memory corresponds to the information-storing section 13. An access to the memory managing table 50 is made when the first control code executing section 41 of the function selecting section 16 requests the access control section 14 to make an access.

The memory managing table 50 has information such as the upper- and lower-limit addresses of a user memory, the start address of a memory 52 in use (to be referred to as a using memory hereinafter), an UNDO address, the end address of the using memory 52, a memory use state informing address, and the like.

The upper- and lower-limit addresses of the user memory define a memory area which can store user's writing information. Each writing information which was recorded in the past is stored in turn from the lower-limit address of the user memory as a file with ID data. The memory area which already stores writing information as a file will be referred to as a used memory 51 hereinafter.

The start address of the using memory 52 indicates a memory address at which recording of new writing information is started, i.e., the end address of the used memory 51. At the subsequent addresses, writing information which is being currently recorded is stored.

The end address of the using memory 52 corresponds to an address from which writing information to be written in future begins to be stored. More specifically, the memory area of writing information recorded so far is defined from the start address to the end address of the using memory 52, and this memory area will be referred to as the "using memory 52" hereinafter. A memory area after the end address of the using memory 52 will be referred to as an "unused memory 53" hereinafter.

The UNDO address is an address for restoring stored writing information to a previous specific state. The UNDO address can be arbitrarily set in the using memory 52. When a writing operation is continued after an UNDO address is set, and then, UNDO processing is executed, writing information after the UNDO address is invalidated to restore a state upon setting of the UNDO address.

A memory use state warning address is an arbitrary address set in the area of the unused memory 53. When the end address of the using memory 52 exceeds the memory use state warning address, a memory use state can be explicitly informed to a user by generating, e.g., a warning tone.

FIGS. 23A to 23C show display examples of the memory use state.

The information input device 10 comprises a display which can graphically display the memory use state. Referring to FIG. 23A, the memory use state is displayed on the first display 18b. On the first display 18b, the left end corresponds to the lower-limit address of the user memory, and the right end corresponds to the upper-limit address of the user memory. The first display 18b displays three memory states ("used memory 51", "using memory 52", and "unused memory 53") shown in FIG. 22 using rectangular regions having different patterns or colors, so that a user can readily understand the memory states.

The display operation on the first display 18b is

section 14 to change the address ((a) of FIG. 26B).

When the writing operation is continued after the UNDO pointer 56 is set, the end address of the using memory 52 eventually becomes larger than the address of the UNDO pointer 56, and the UNDO pointer 56 is located in the area of the using memory 52 ((b) of FIG. 26B). When writing information input after the UNDO pointer 56 is set is to be invalidated to restore writing information upon setting of the UNDO pointer 56, an UNDO command is executed in a menu mode (to be described later). Upon execution of the UNDO command, the end address of the using memory 52 is changed to the address of the UNDO pointer 56, and the memory state upon setting of the UNDO pointer 56 is restored ((c) of FIG. 26B).

FIGS. 27A and 27B are views showing the menu selecting operation.

When the first rotary switch 35 is rotated through 90-degree in a specific direction (e.g., the clockwise direction), as shown in FIG. 27B, from an initial state shown in FIG. 27A, the operating section 15a outputs operation information to the control code selecting section 40. The control code selecting section 40 requests a sixth control code executing section 46 to execute a code for selecting various menu items, thus setting a menu selecting mode.

FIG. 28 shows the menu selecting operation in more detail.

When the second rotary switch 36 is rotated in the menu selecting mode shown in FIG. 27B, the operating section 15b outputs operation information to the control code selecting section 40. Since the operation mode is the menu selecting mode, the control code selecting section 40 outputs the corresponding information to the menu selecting code which is being executed by the sixth control code executing section 46. The sixth control code executing section 46 outputs a code for displaying a character string corresponding to the menu item, which is currently selected according to the operation information, to the information display section 18 on the basis of the menu selecting code and the operation information. The information display section 18 controls the second display 18c to display a menu corresponding to the received code. In FIG. 28, the sixth control code executing section 46 outputs a code for displaying a character string corresponding to a FILE SAVE function.

As described above, various menu items are displayed on the display by scrolling, as in FIGS. 21A and 21B, and a user can specify a desired menu item (function).

FIGS. 29A and 29B show an operation executed when all the contents of the using memory are to be erased. FIG. 29A shows the control flow, and FIG. 29B shows states before and after the operation.

When the first push button switch 38 is clicked in the menu selecting mode shown in FIG. 27B, the currently displayed menu item is selected and executed. An operating section 15d outputs operation information to the control code selecting section 40. The control code selecting section 40 outputs the operation information to the menu selecting code which is being executed by the sixth control code executing section 46. The sixth control code executing section 46 executes an ALL ERASE code selected by the operation information on the basis of the menu selecting code. The sixth control code executing section 46 requests the access control section 14 to return the end address of the using memory 52 to the start address of the using memory 52 on the basis of the ALL ERASE code, thus invalidating whole writing information which is being written.

FIG. 30 shows an operation based on inclination recognition of the information input device 10. The inclination recognizing section 17 automatically selects a specific function.

An inclination recognizing device is cylindrical, and pairs of switches 68 (first switches 66 and second switches 67) are respectively arranged at upper and lower opposing positions of the cylinder. The cylinder incorporates a conductor 65 which is free to move vertically.

When the pen tip 60 of the information input device 10 faces down, the conductor 65 is moved by gravity to a position where it is clamped between the first switches 66. When the first switches 66 are electrically connected, a circuit corresponding to the first switches 66 in the inclination recognizing section 17 is enabled, and outputs corresponding inclination information to the control code selecting section 40. The control code selecting section 40 selects a writing mode from the inclination information, and requests the second control code executing section 42 to execute a writing mode code.

When the pen tip 60 of the information input device 10 faces up, the conductor 65 is moved by gravity to a position where it is clamped between the second switches 67. When the second switches 67 are electrically connected, a circuit corresponding to the second switches 67 in the inclination recognizing section 17 is enabled, and outputs corresponding inclination information to the control code selecting section 40. The control code selecting section 40 selects an eraser mode from the inclination information, and requests the second control code executing section 42 to execute an eraser mode code.

FIGS. 31A to 31C show an operation for erasing writing information. The information input device 10 comprises information writing sections 11a and 11b in the pen tip 60 and in an end portion opposite to the pen tip 60. The information writing section 11b in the end portion opposite to the pen tip 60 will be especially referred to as an information erasing section hereinafter.

When a writing operation is performed with the information writing section 11b while the pen tip 60 of

second display 18c (FIG. 35A).

When the second rotary switch 36 is rotated, a character appears at the cursor position, and an English letter to be displayed changes in correspondence with the rotational direction and the rotational amount. When the first push button switch 38 is clicked in a state wherein a required English letter is displayed at the cursor position, the character at the cursor position is determined, and the cursor moves to the right by one character (FIG. 35B). When the first push button switch 38 is double-clicked in a state wherein all the characters are determined, written image information is recorded as a file having the determined character string as ID data (FIG. 35C). For example, the first control code executing section 41 records stored information of a written image shown in FIGS. 12, 32, and 33 as one file in the information storing section 13 via the access control section 14 to have a character string determined in the SAVE MODE as its file name. In this manner, writing information with designated ID data can be searched from a plurality of pieces of writing information stored in the information storing section 13.

In the above-mentioned operation, the first control code executing section 41, which is executing the SAVE MODE code, issues a request to the access control section 14, and the access control section 14 changes the using memory 52 to the used memory 51 and, at the same time, updates the start address of the using memory 52, the UNDO address, and the memory use state informing address to the end address of the using memory 52. As a result, an initial state wherein a newly written image can be recorded is set.

FIGS. 36 and 37 show the second method of assigning ID data to writing information in this embodiment. When a menu item for assigning ID data to writing information is selected in the methods shown in FIGS. 27A to 29B, a hand-written character is recognized, and writing information can be recorded as a file having the recognition result as ID data.

When a SAVE MODE2 is selected in the menu mode, the contents on the second display 18c are cleared, and the cursor is displayed at the left end of the display 18c. When the first character of a file ID is written with the information input device 10, the first control code executing section 41 requests the access control section 14, via a SAVE MODE2 code, to record writing information recognized by the position recognizing section 12 in a specific system memory area.

When the first push button switch 38 is double-clicked after one character is written, the operating section 15d outputs operation information to the control code selecting section 40, and the control code selecting section 40 outputs the received information to the first control code executing section 41. The first control code executing section 41 requests the access control section 14 to output writing information of the character to a character recognizing section 21. The character recognizing section 21 performs character recognition based on the received writing information of the character, and outputs the recognition result to the control code selecting section 40. The control code selecting section 40 outputs the recognition result to the first control code executing section 41. The first control code executing section 41 displays the recognized character, and at the same time, advances the cursor to the right by one character, thus waiting for the next character writing input. When the first push button switch 38 is kept depressed for a predetermined period of time or longer upon completion of the input of all the characters, the first control code executing section 41 records writing information as a file having the recognized input character string as ID data on the basis of output information from the operating section 15 and the time recognizing section 20.

As described above, ID data written on a writing medium can be read later, and writing information with ID data which coincides with the read ID data can be searched from the memory.

In this case, the access control section 14 changes the using memory 52 to the used memory 51, and updates the start address of the using memory 52, the UNDO address, and the memory use state informing address to the end address of the using memory 52. As a result, an initial state wherein a newly written image can be recorded is set.

The first control code executing section 41 in FIGS. 35A to 35C, and FIGS. 36 and 37 has a function associated with information recording, and a function associated with a menu display/menu operation.

FIG. 38 shows the arrangement of the position information holding device 25.

The position information holding sections 26 each having unique position information are arranged at the respective positions on the position information holding device 25. When the position information is detected by the information input device 10, the absolute coordinates of the information input device 10 on the position information holding device 25 can be obtained.

FIG. 39 shows a method of using the position information holding device 25 by the information input device 10.

Since the position recognizing section 12 of the information input device 10 converts position information into the absolute coordinates, when the position information holding devices 25 having various sizes are used, position information conversion maps corresponding to these position information holding devices 25 are required.

Thus, a position information conversion map 33 corresponding to the position information holding device 25 having a maximum size (a portion indicated

writing information display device 30, as shown in FIG. 41, in accordance with instructions from the second rotary switch 36 and the first push button switch 38.

When the second rotary switch 36 is rotated, writing information is reproduced at high speed in units of recorded files. In this case, images are reproduced like video reproduction using a jog dial. When reproduced images approach target file information, the first push button switch 38 is clicked to perform frame-scan reproduction. Images can be reproduced in the positive or negative direction depending on the rotational direction of the switch 36. For this reason, even when target file information is gone past during high-speed reproduction, it can be searched again in the reverse direction.

The same reproduction as described above can be performed for one file. More specifically, after writing information of a specific file is selected, high-speed reproduction or frame-scan reproduction can be performed by the above-mentioned method in the order written from a writing start state to a writing end state.

In some cases, a certain writing content in a written image may be designated during writing, and writing information corresponding to the designated writing content may be searched from the information storing section 13. FIGS. 44A to 44C show an example for searching designated writing information from the information storing section 13.

This function is called, for example, when a portion of a written image is to be output to another information input device 10 during writing with the information input device 10. In order to search a portion of a written image from the information storing section 13, the following two methods are available.

The first method is a method shown in FIG. 44A. When Select Mode 1 is selected in the menu mode, a mode for searching a written image in a region enclosed within a closed curve is set. When a closed curve is written on a paper sheet with the pen tip 60, and the first push button switch 38 is double-clicked, the stroke information of the closed curve is recorded as a special code corresponding to a search region.

The second method is a method shown in FIG. 44B. When Select Mode 2 is selected in the menu mode, a mode for searching a written image in a rectangle defined by two points is set. When two points on a diagonal line of a rectangle are designated on a paper sheet sing the pen tip 60, and the first push button switch 38 is double-clicked at the respective points, the stroke information of the rectangular region is recorded as a special code corresponding to a search region.

In the system memory of the information storing section 13 of the information input device 10, a virtual bitmap area is reserved. When a virtual bitmap search area is recorded, the access control section 14 develops the virtual bitmap search area. In this case, the virtual bitmap search area is developed on the virtual bitmap area, so that bit information in the virtual bitmap search area is 1, and bit information outside the virtual bitmap area is 0, in the same manner as the erasing region shown in FIG. 34A or 34B.

Furthermore, a working area for searching writing information is reserved on the system memory of the information storing section 13 of the information input device 10, and can temporarily record searched writing information.

Then, writing information stored in the using memory 52 which stores an image which is being currently written is developed in turn on the virtual bitmap area. If the developed writing information corresponds to a point outside the virtual bitmap area, it is skipped without being checked. If the developed writing information corresponds to a point in the virtual bitmap area, bit information of the virtual bitmap area at a point where the writing information is located is referred to. If the bit information is 0, since it indicates a point outside the search region, the writing information is skipped. However, if the bit information is 1, since it indicates a point inside the search region, the writing information is copied to the working area for searching. By repeating this operation up to the last writing information in the using memory 52, writing information in the search region is searched from the information storing section 13.

FIGS. 45 and 46 are views showing information exchange of a written image between a plurality of information input devices 10 using the position information holding device 25.

The position information holding device 25 has two or more connectors which can receive the pen tip 60 of the information input device 10, and these connectors are coupled to each other via a bidirectional communication interface (information exchange I/F section 27).

The pen tip 60 of the information input device 10 is connected to the information exchange section 19 and can exchange information with the information exchange section 19.

When the pen tip 60 of one information input device 10 is inserted into a connector, the information exchange section 19 of the information input device 10 is connected to the information exchange I/F section 27 of the position information holding device 25, and the information input device 10 is connected, via the information exchange I/F section 27, to an information exchange section 19 of another information input device 10 inserted into another connector. The pen tip 60 of the information input device 10 and a connector of the position information holding device 25 can exchange information signals directly by contacting the conductive pen tip 60 and the connector, or via a weak radio communication by bringing the pen tip 60 having a very weak radio function and the

tip 60 of the information input device) can be obtained.

FIG. 48 shows another arrangement of the position information holding device 25 of the present invention. As shown in FIG. 48, unique dielectric members 71 are printed on respective layers by a semiconductor printing technique, and these layers are stacked to obtain a multi-layered structure, thus realizing the position information holding device 25, which has unique dielectric constants at respective dots.

FIG. 49 shows a modification of the first arrangement of the position recognizing system of the present invention. In this case, a writing medium (paper sheet) is present between the information input device and the position information holding device.

Dielectric members 71 having unique dielectric constants and conductive plates 72 arranged below the dielectric members 71 are arranged in a matrix at the respective positions of the position information holding device 25. These conductive plates 72 are connected to a single line, and the line is directly connected to a terminal 73 exposed to the surface.

The information input device 10 comprises the position recognizing section 12 having an oscillating circuit 86 and a waveform detecting circuit 87, and the conductive information writing section 11, which are connected in series with each other. The information writing section 11 has writing means which consists of a conductive material, and projects from the central portion of a conductive plate 72 having the same shape as that of the conductive plate 72 embedded in the position information holding device 25. The conductive line 88 extends from the rear end portion of the pen, and is connected to the terminal 73 of the position information holding device 25 when the pen is used.

When a thin writing medium is placed on the position information holding device 25, and information is written thereon with the information writing section 11, the position recognizing section 12 is enabled by a switch in the operating section 15 of the information writing section 11.

When the conductive plate 72 of the information writing section 11 is placed above a certain capacitor portion on the surface of the position information holding device 25, the information input device 10 and the position information holding device 25 form a closed circuit. Since a waveform detected by the waveform detecting circuit 87 changes depending on the capacitance of the capacitor portion formed by the information writing section 11, the capacitance of the capacitor portion which contacts the information writing section 11 is obtained, and the absolute position of the information writing section 11 on the position information holding device 25 can be obtained. More specifically, when information is written on a paper sheet, the position information of the written information is simultaneously stored in the pen.

FIGS. 50A and 50B show the second arrangement of the position recognizing system according to the present invention.

As shown in FIG. 50A, magnetic members 74 having unique magnetic flux densities (which are different from each other depending on positions) are arranged in a matrix at the respective positions of the position information holding device 25.

The information input device 10 comprises the conductive information writing section 11, and the position recognizing section 12 having a magnetic sensor circuit which is constituted by a magnetic flux density detecting circuit 89 and a magnetoresistance element 90 using an electromagnet.

When a thin writing medium 29 is placed on the position information holding device 25, and information is written thereon with the information writing section 11, the position recognizing section 12 is enabled by the operating section 15 of the information input device 10.

When the magnetoresistance element of the information writing section 11 is placed above a certain magnetic member 74 on the position information holding device 25, the resistance of the magnetoresistance element 90 changes, and a potential detected by a voltage sensor 91 also changes. Thus, the magnetic flux density of the magnetic member 74 at the position of the information writing section 11 is obtained based on the potential difference detected by the voltage sensor 91, and the absolute position of the information writing section 11 on the position information holding device 25 can be recognized.

FIGS. 51A and 51B show the third arrangement of the position recognizing system according to the present invention.

As shown in FIG. 51A, penetration members 75 having unique transmittances (which are different from each other depending on positions), and underlying reflection members 76 are arranged in a matrix at the respective positions on the position information holding device 25.

The information input device 10 comprises the information writing section 11, and the position recognizing section 12 which has a light-emitting circuit 92, a light-receiving circuit 94, and a transmittance detecting circuit 93. The information writing section 11 comprises a bundle of a plurality of optical fibers 95, and a writing recognizing switch (the second push button switch 39) surrounds these optical fibers 95. The optical fibers 95 include light-emitting optical fibers 95a and light-receiving optical fibers 95b.

As shown in FIG. 51B, the bundle of optical fibers 95 is normally retracted in the pen tip 60. When the pen tip 60 is pressed against a writing medium, the second push button switch 39 is pushed, and the position recognizing section 12 is enabled. At the same time, the bundle of optical fibers 95 projects from the

incorporates a micro coil 78. When the information writing section 11 is pressed against the surface on the position information holding device 25, an oscillation current flows through the micro coil 78 by a switch of the pen tip 60, and an oscillating magnetic field is generated in the pen tip 60.

The magnetic field generated in the pen tip 60 influences the micro coil 78 of the position information holding device 25 at the position of the pen tip 60, and the position information in the corresponding memory element 79 is output onto the data bus 80a via the above-mentioned process. The position information is output to the position recognizing section 12 of the information input device 10. With the above-mentioned method, the absolute position of the information input device 10 on the position information holding device 25 can be recognized.

A receiving section of a serial magnetic signal may be connected to the micro coil in the pen tip 60, and an output section which can output position information stored in the corresponding memory element 79 may be connected to the micro coil 78 of the corresponding memory element 79, so that position information can be exchanged without connecting any signal line.

In each of the arrangements shown in FIGS. 47 to 53, when the position information of each position on the position information holding device 25 is expressed by an analog element in a multi-value logic manner, a difference between numerical values of position information is set to be equal to or larger than a detection error, thereby preventing a recognition error of address information. For example, when each address information is expressed by the dielectric constant of a dielectric, the dielectric constants may be set to be 0, 5, 10,....

FIG. 54 shows an arrangement adopted when the position of the information writing section of the present invention is digitally recognized.

Unique digital position information is stored at each position on the position information holding device 25, and each position information is held as information expressed by a plurality of bits arranged in a square or rectangular pattern.

The pen tip 60 of the information input device 10 holds a plurality of heads which are arranged in the same pattern as that of bits of each position information. Each head is used for reading one bit information.

When the pen tip 60 is brought into contact with the position information holding device 25, a switch of the pen tip 60 enables the heads, and the plurality of heads read one position information expressed by a plurality of bits. The read position information is output to the position recognizing section 12.

FIGS. 55A to 55C show other arrangements of FIG. 54.

Unique digital position information is held at each position on the position information holding device 25.

Each position information on the position information holding device 25 is stored as digital information expressed by n bits (4 bits in this case) which are arranged in a square pattern, as shown in FIG. 55. Frame identification information bits (12 bits in this case) are stored in a square pattern to surround the 4-bit digital information. More specifically, in this case, 16 bits correspond to one dot. On the other hand, the information writing section 11 of the information input device 10 comprise a 20 × 20 matrix of reading heads each of which is smaller than the size of a section for storing 1-bit data on the position information holding device 25. The size of the information writing section 11 as a whole is larger than a portion for storing one position information on the position information holding device 25. The information writing section 11 freely moves on the position information holding device 25 in correspondence with the movement of the pen tip 60.

In this case, when each reading head extends across a boundary between bits "0" and "1" on the position information holding device 25, information cannot often be accurately read. However, since 1-bit information on the position information holding device 25 is detected by a plurality of heads, heads other than those on the boundary can detect correct bit information. Then, image processing is performed for the detected bit information, thereby restoring a plurality of pieces of "0" or "1" information to independent "0" or "1" information.

When the heads of the information writing section 11 are inclined clockwise at about 45x with respect to the storing direction of position information on the position information holding device 25, as indicated by oblique frames, the information writing section 11 detects position information in a state shown in a lower portion of FIG. 55. A bold frame in FIG. 55 represents that 1 bit on the holding device is read by a plurality of heads. However, since the frame identification information bits are arranged to be distinguished from address information, a portion other than the frame identification information bits never forms the same information pattern as the frame identification information bits. The read pattern in FIG. 55 shows that a group of frame information bits are read.

Thus, matching processing of the frame identification information pattern is performed based on information obtained after the above-mentioned restoration processing, and the inclination of the frame identification information is calculated based on the matching state of the frame identification information. As a result, the direction of the position information detection section can also be obtained.

In this manner, even when the information writing section 11 is moved to have an arbitrary path and inclination with respect to the position information hold-

tion are simultaneously detected, at least position information values "1" to "4" can be arranged in a specific pattern. In this case, the number of bits required for expressing one position information can be 3 bits.

Claims

1. An information input device characterized by comprising:

information writing means (11) for writing information on a writing medium;

position recognizing means (12) for recognizing a position of said information writing means (11) on the writing medium; and

information storing means (13) for storing information obtained from said position recognizing means (12).

2. An information input device according to claim 1, characterized in that said information writing means (11) includes:

a acceleration sensor (31) for detecting acceleration of said information writing means (11) during writing;

a first integrator (32) for integrating said acceleration ad calculating a velocity of said information writing means (11); and

a second integrator (33) for integrating said velocity and calculating a position of said information writing means (11).

3. An information input device according to claim 1, characterized in that said information writing means (11) includes character recognizing means (21) for recognizing a character written on said writing medium.

4. An information input device according to claim 1, characterized in that said position recognizing means (12) includes means for determining a position which said acceleration sensor (31) is activated is an origin.

5. An information input device according to claim 1, characterized in that said information storing means (13) includes means for storing a information attribute code including width and density of a line and a writing information code which writing information is represented by code.

6. An information input device according to claim 1, characterized in that said information writing means (11) includes means for detecting a position of said information input device.

7. An information input device according to claim 1, characterized by further comprising:

instruction means (15, 17) for giving instruction to perform a predetermined control; and

control means (14) for controlling said information storing means (13) on the basis of an instruction of said instruction means (15, 17).

8. An information input device according to claim 7, characterized by further comprising function selecting means (16) for selecting predetermined functions on the basis of the instruction of said instruction means (15, 17).

9. An information input device according to claim 7 or 8, characterized in that said instruction means (15) includes at least one operating means (35 to 39); and

said control means (14) has a plurality of access modes and includes means for controlling said information storing means (13) according to said access modes.

10. An information input device according to claim 9, characterized in that said operating means (35 to 39) includes means for turning on or off of the power source of said information input device.

11. An information input device according to claim 9, characterized in that said operating means (35 to 39) includes means for changing at least one of width of line and density thereof.

12. An information input device according to claim 9, characterized in that said operating means (35 to 39) includes memory use amount setting means (38) for informing to a user when an use amount of said information storing means (13) is equal to or more than a predetermined value.

13. An information input device according to claim 9, characterized in that said operating means (35 to 39) includes UNDO pointer setting means (39) for canceling information stored before a UNDO goiter is set.

14. An information input device according to claim 9, characterized in that said operating means (35 to 39) includes means (35, 36) for storing a desired writing information as one file.

15. An information input device according to claim 9, characterized in that said operating means (35 to 39) includes means (35, 36, 38) for adding identification information to said file.

16. An information input device according to claim 9, characterized in that said operating means (35 to 39) includes means (35, 38) for canceling all writing information.

17. An information input device according to any one of claim 7 to claim 16, characterized by further comprising display means (18) for displaying at least one of an access mode of said control means (14) and an operating content thereof.

18. An information input device according to claim 7 or 8, characterized in that said instruction means (15) includes inclination detecting means (17) for detecting an inclination state of a body of said information input device.

19. An information input device according to claim 7 or 8, characterized in that said control means (14) includes means for selecting one of a writing mode and an erasing mode on the basis of a detecting result of said inclination detecting means.

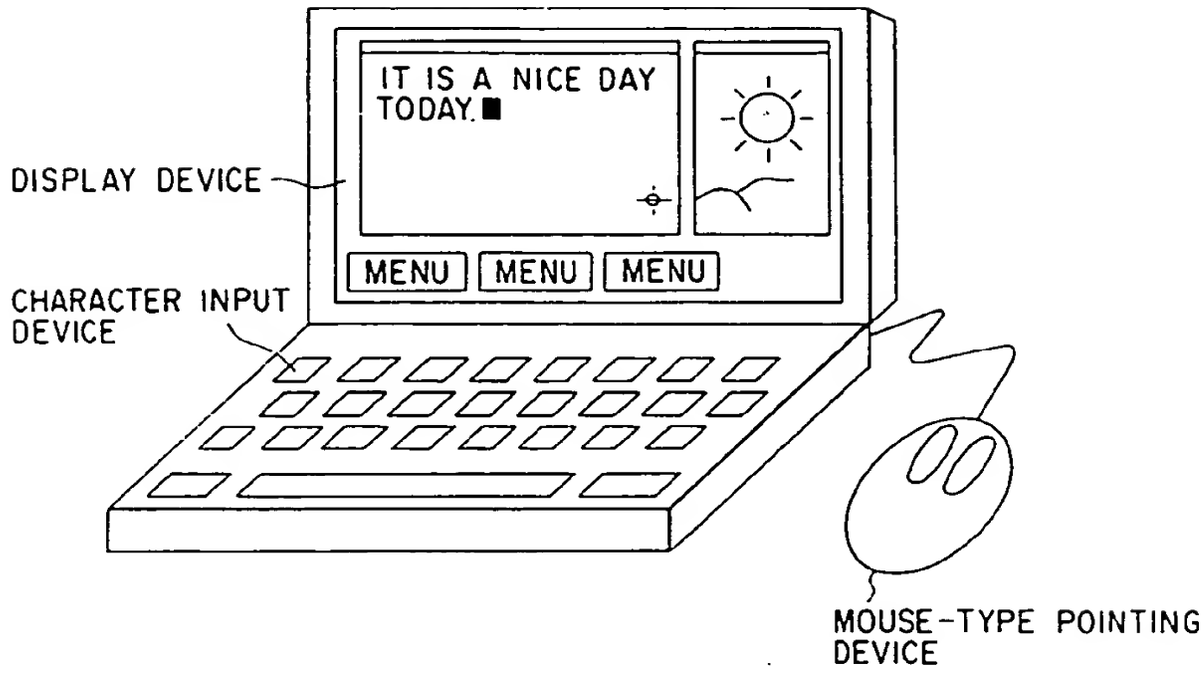


FIG. 1

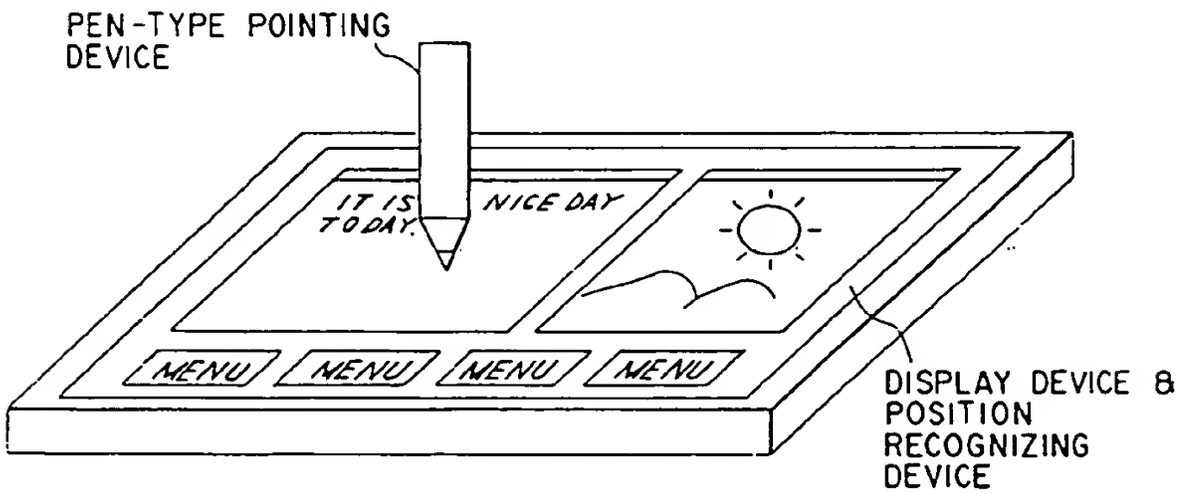
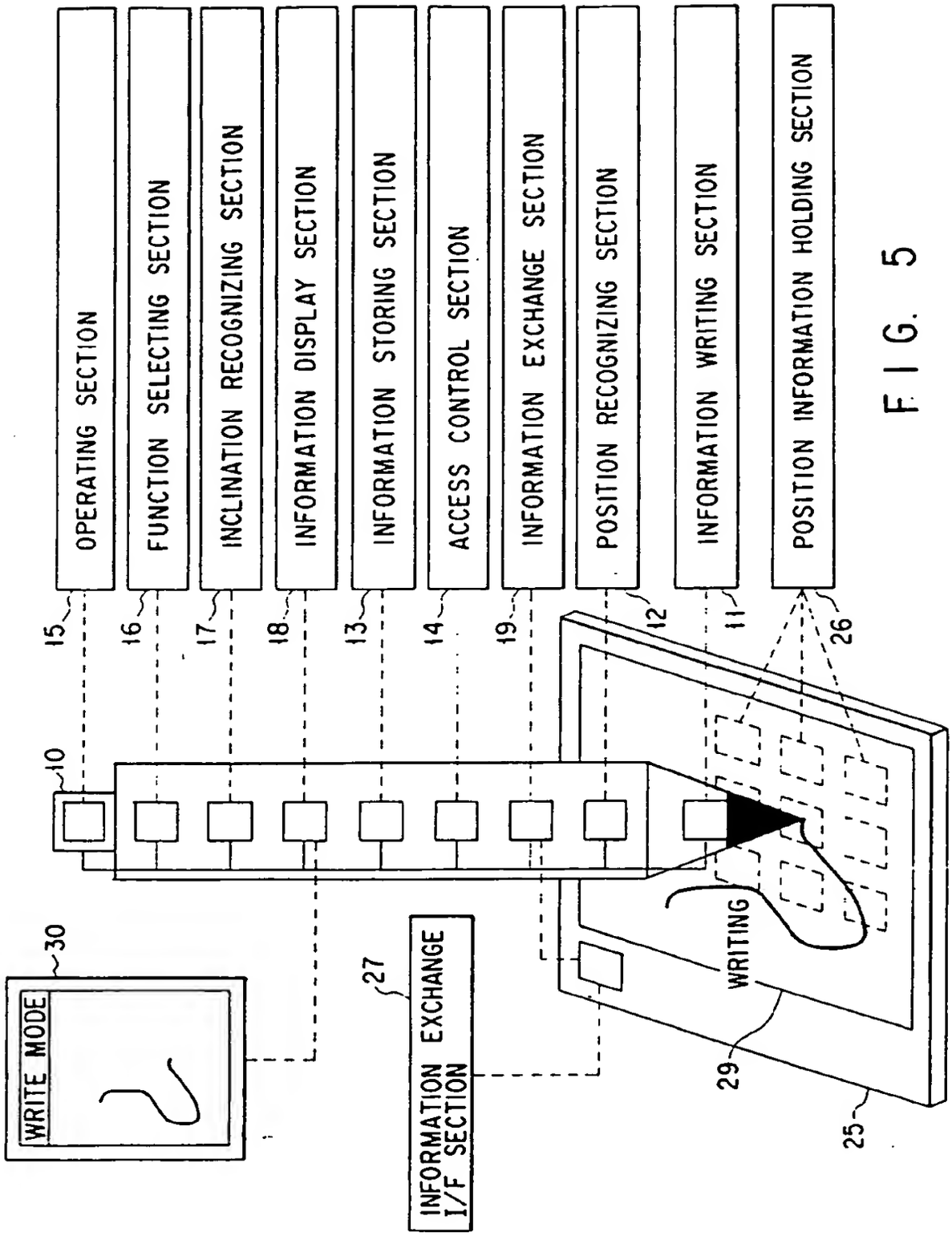


FIG. 2


OPERATING SECTION
FUNCTION SELECTING SECTION
INCLINATION RECOGNIZING SECTION
INFORMATION DISPLAY SECTION
INFORMATION STORING SECTION
ACCESS CONTROL SECTION
INFORMATION EXCHANGE SECTION
POSITION RECOGNIZING SECTION
INFORMATION WRITING SECTION
POSITION INFORMATION HOLDING SECTION
15
16
17
18
13
14
19
12
11
26
10
30
WRITE MODE
27
INFORMATION EXCHANGE I/F SECTION
WRITING
29
25

F I G. 5

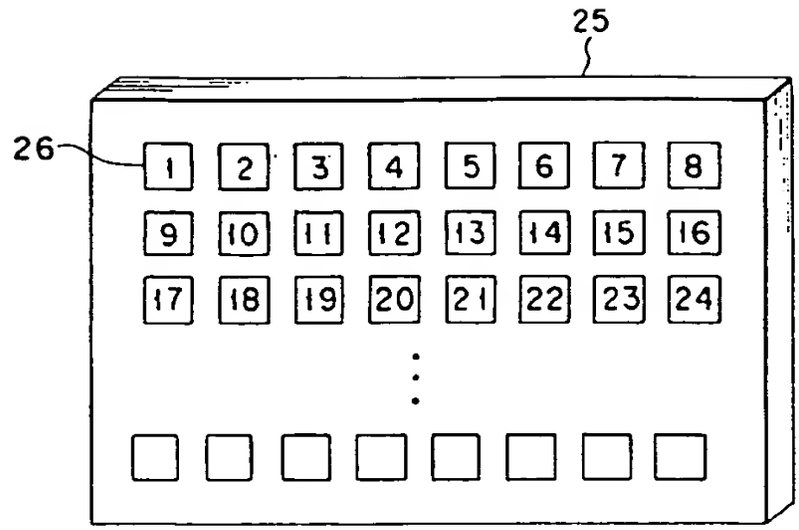


FIG. 7A

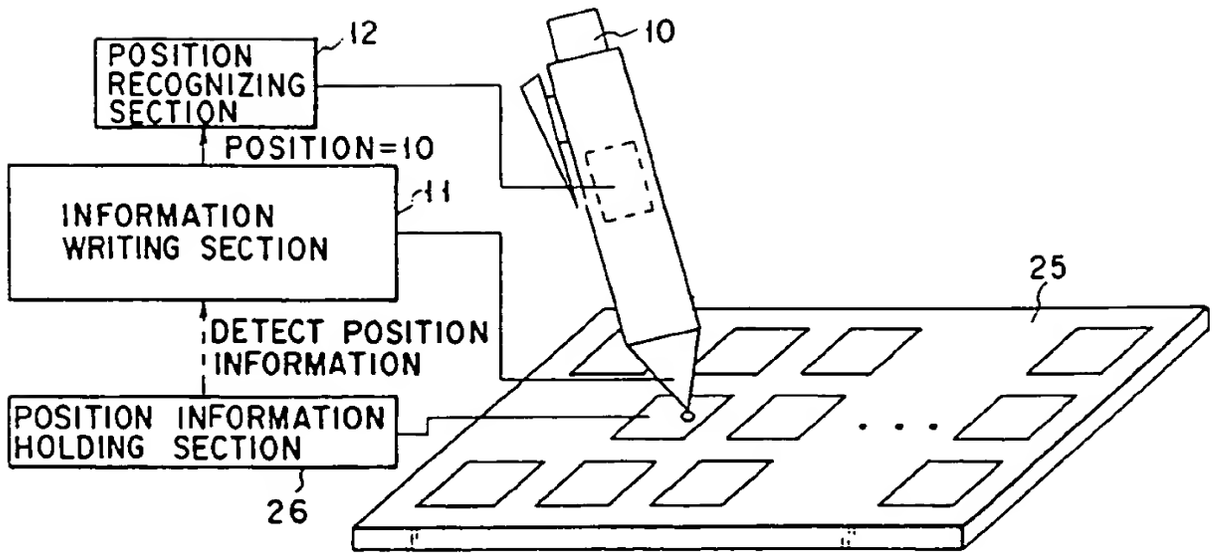


FIG. 7B

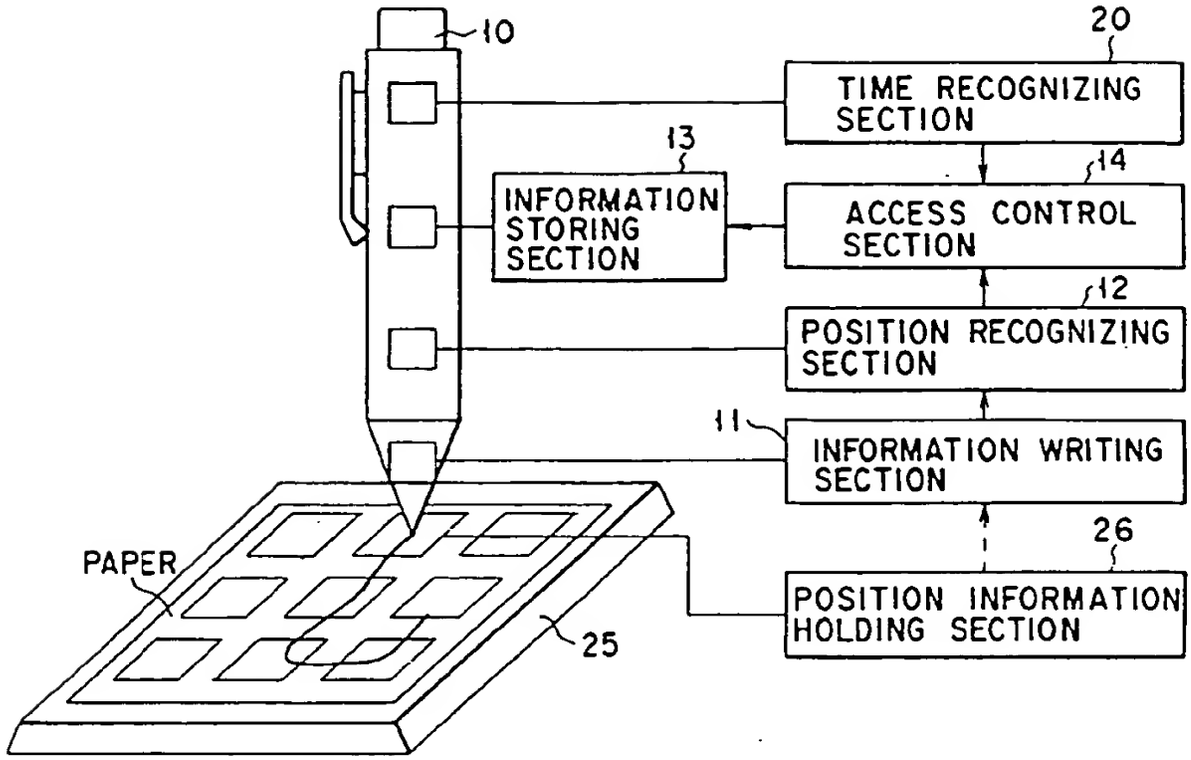


FIG. 10

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64

FIG. 11B

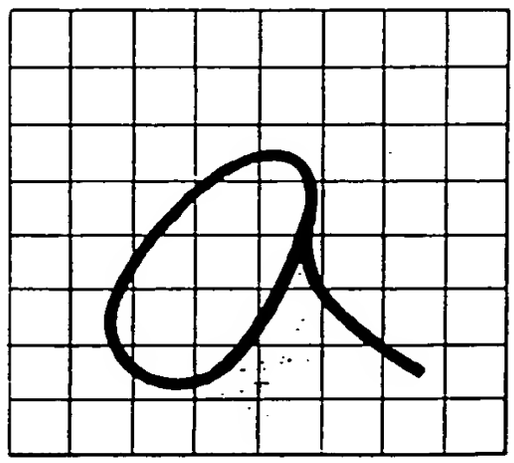


FIG. 11A

FIG. 14

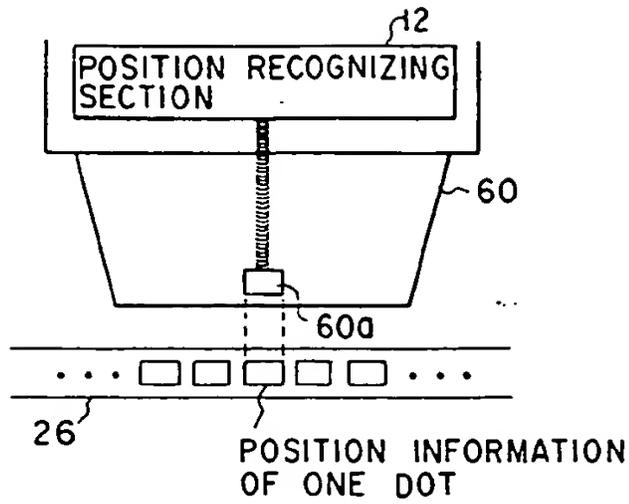


FIG. 15

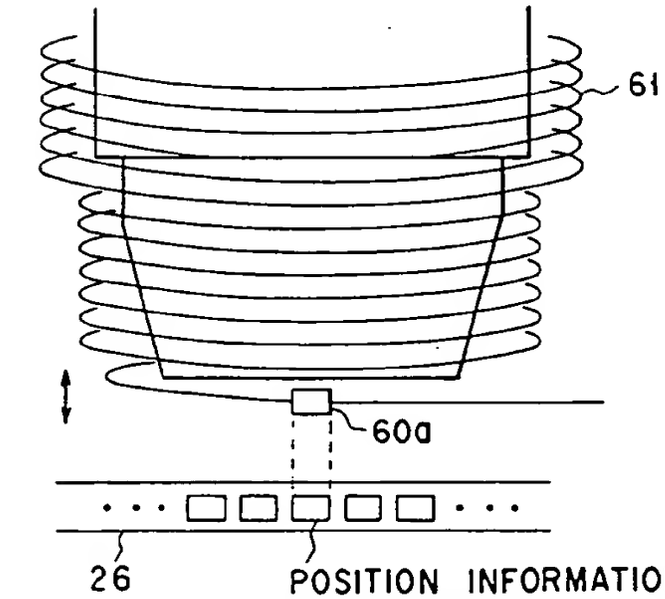
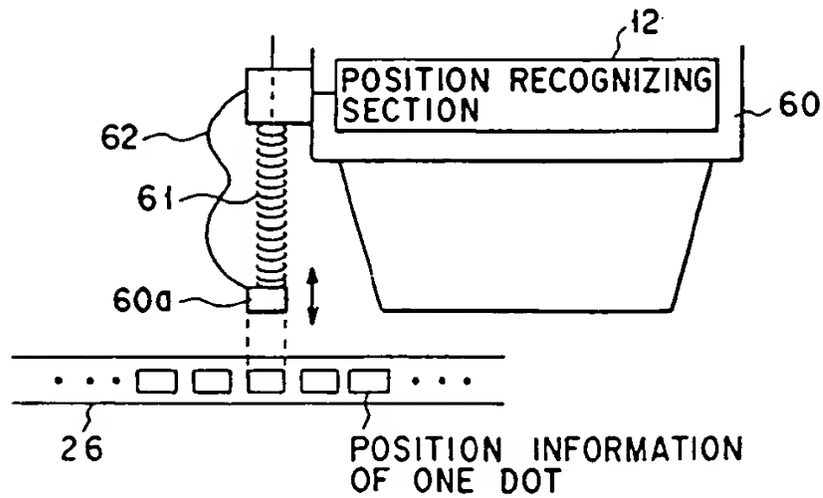


FIG. 16



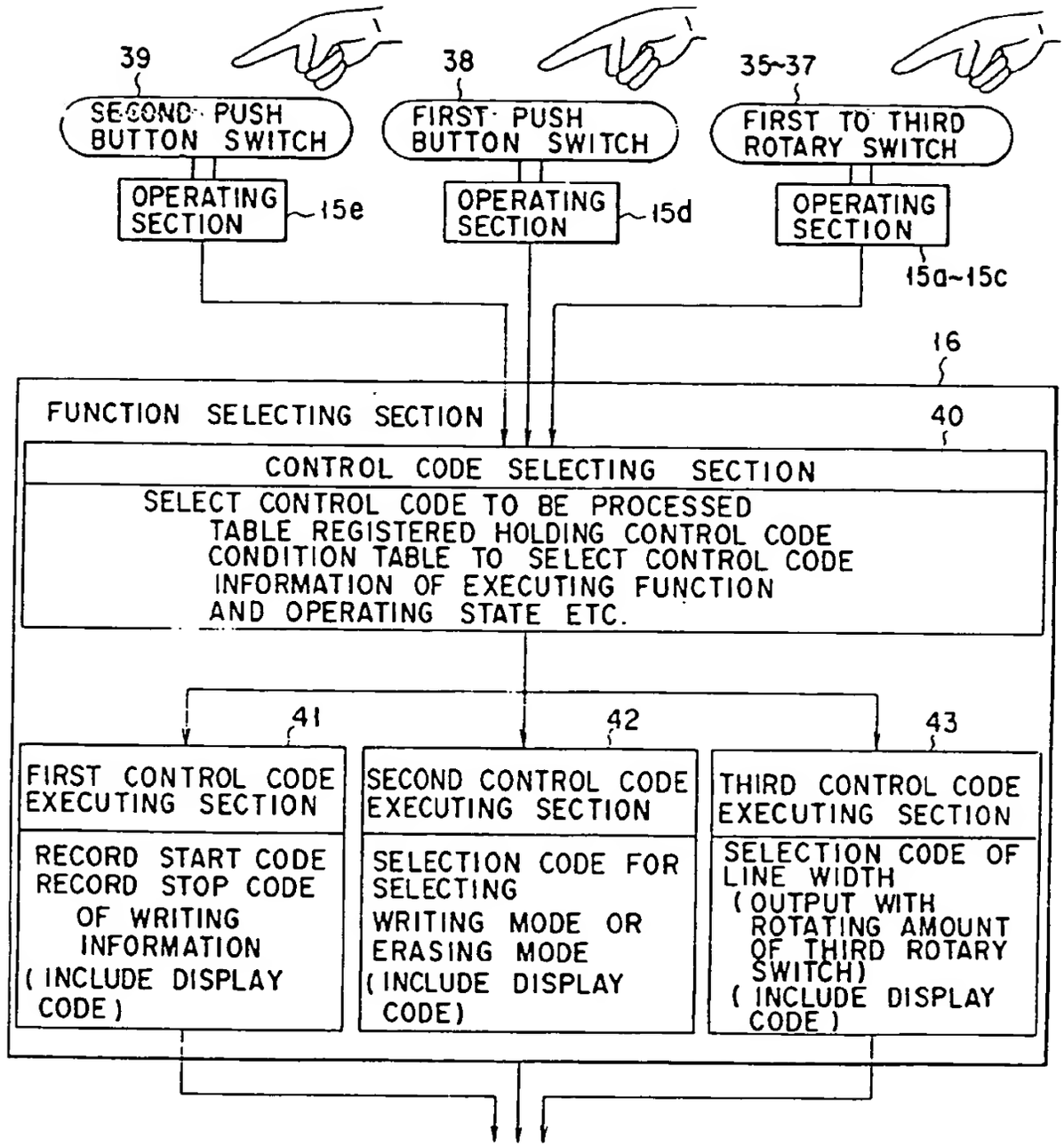


FIG. 18

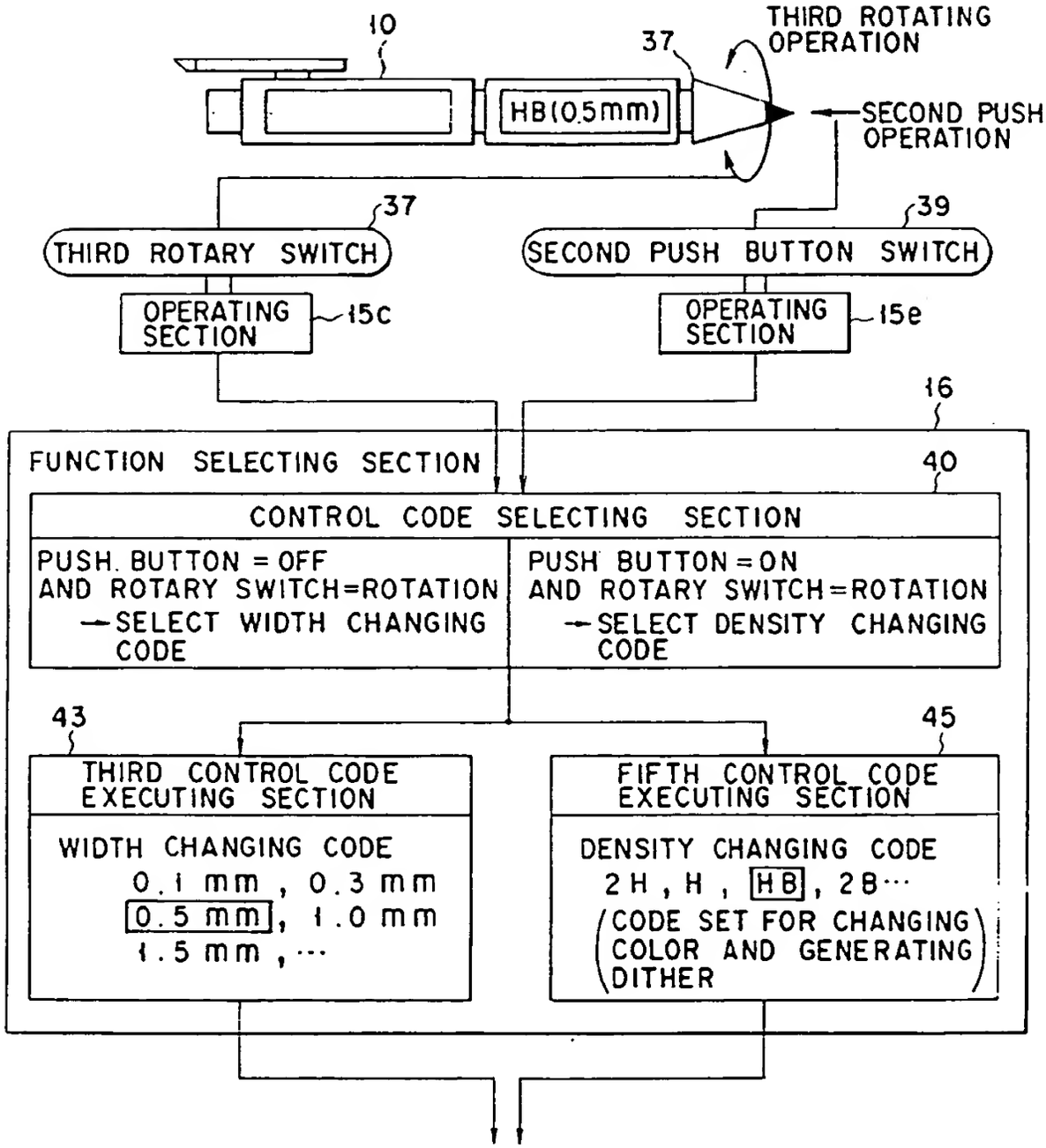


FIG. 20

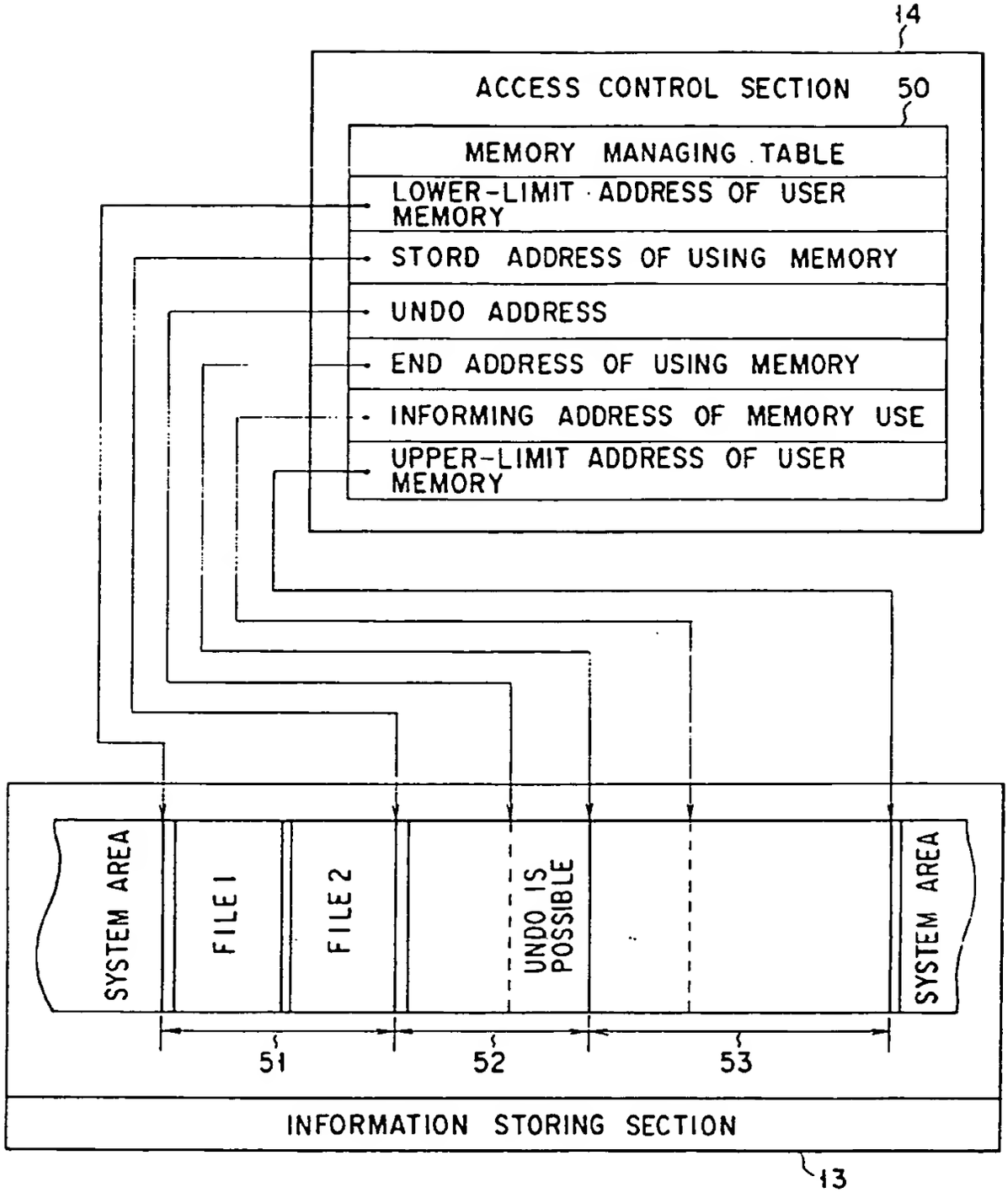


FIG. 22

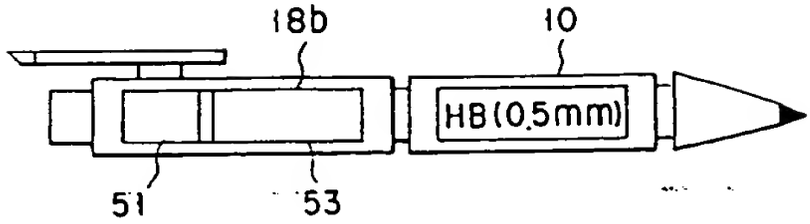


FIG. 24A

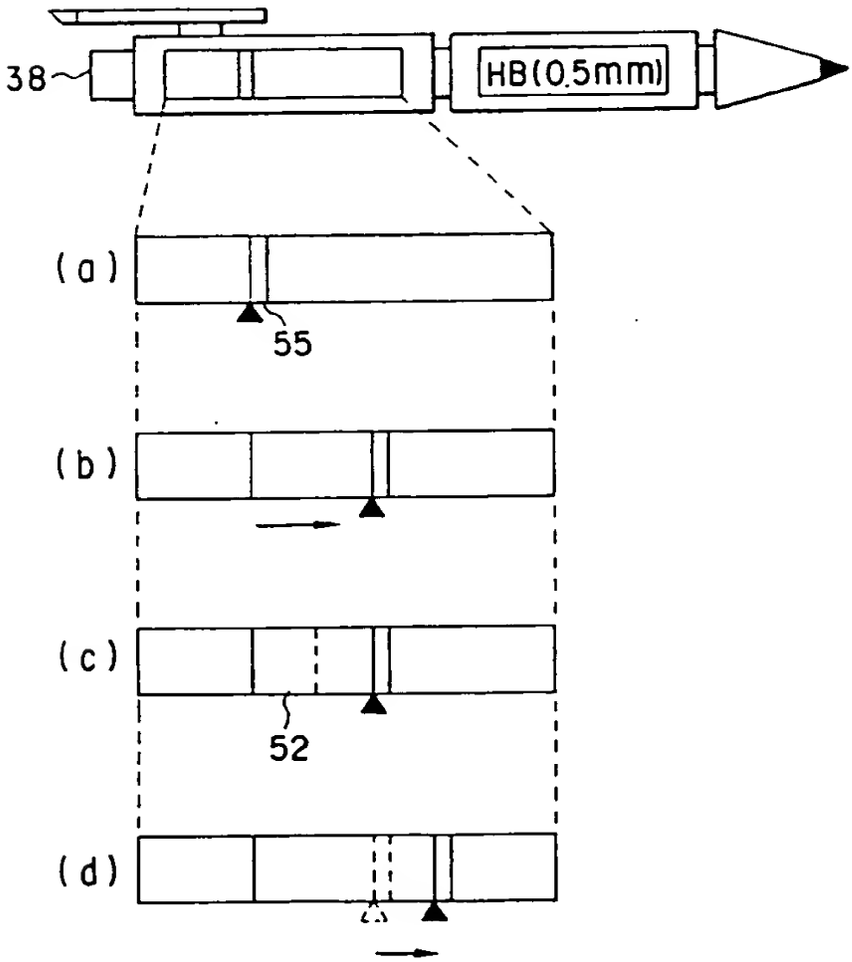


FIG. 24B

FIG. 26A

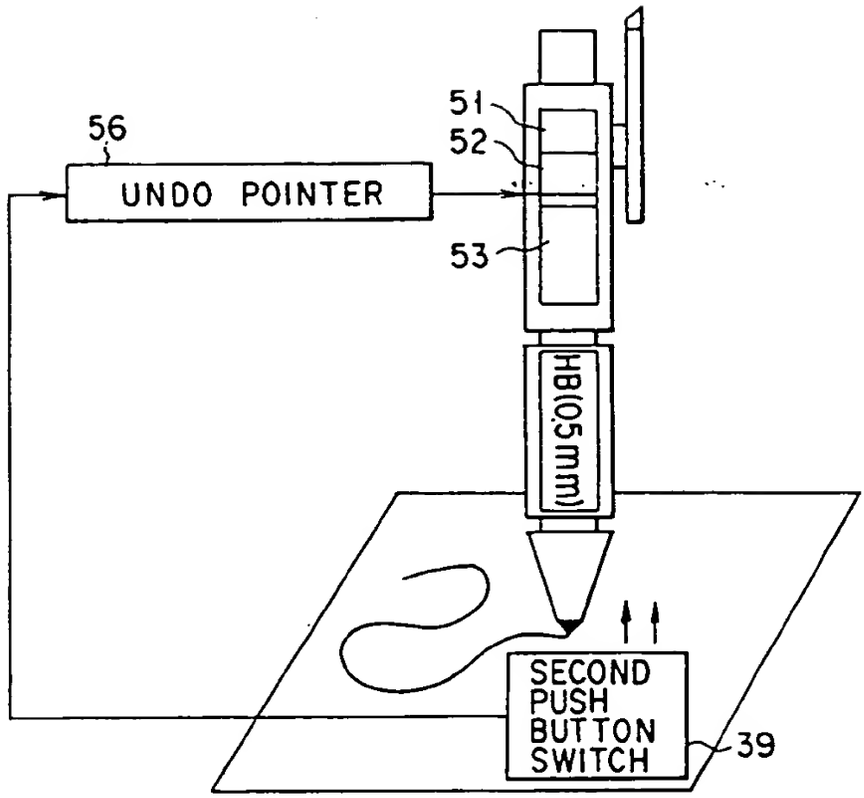
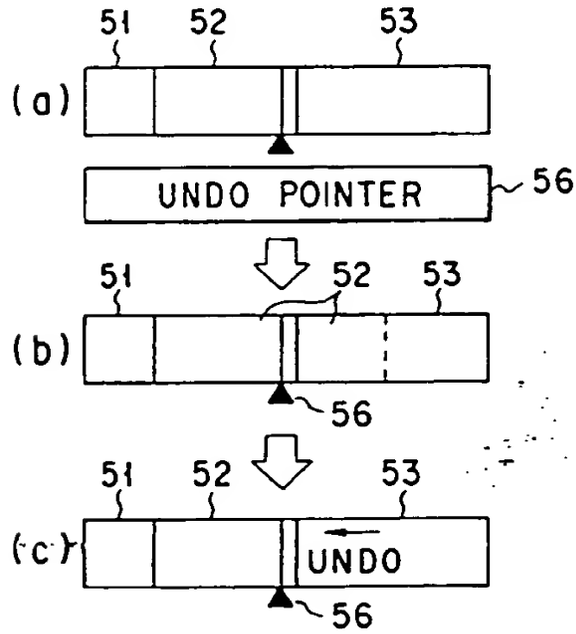


FIG. 26B



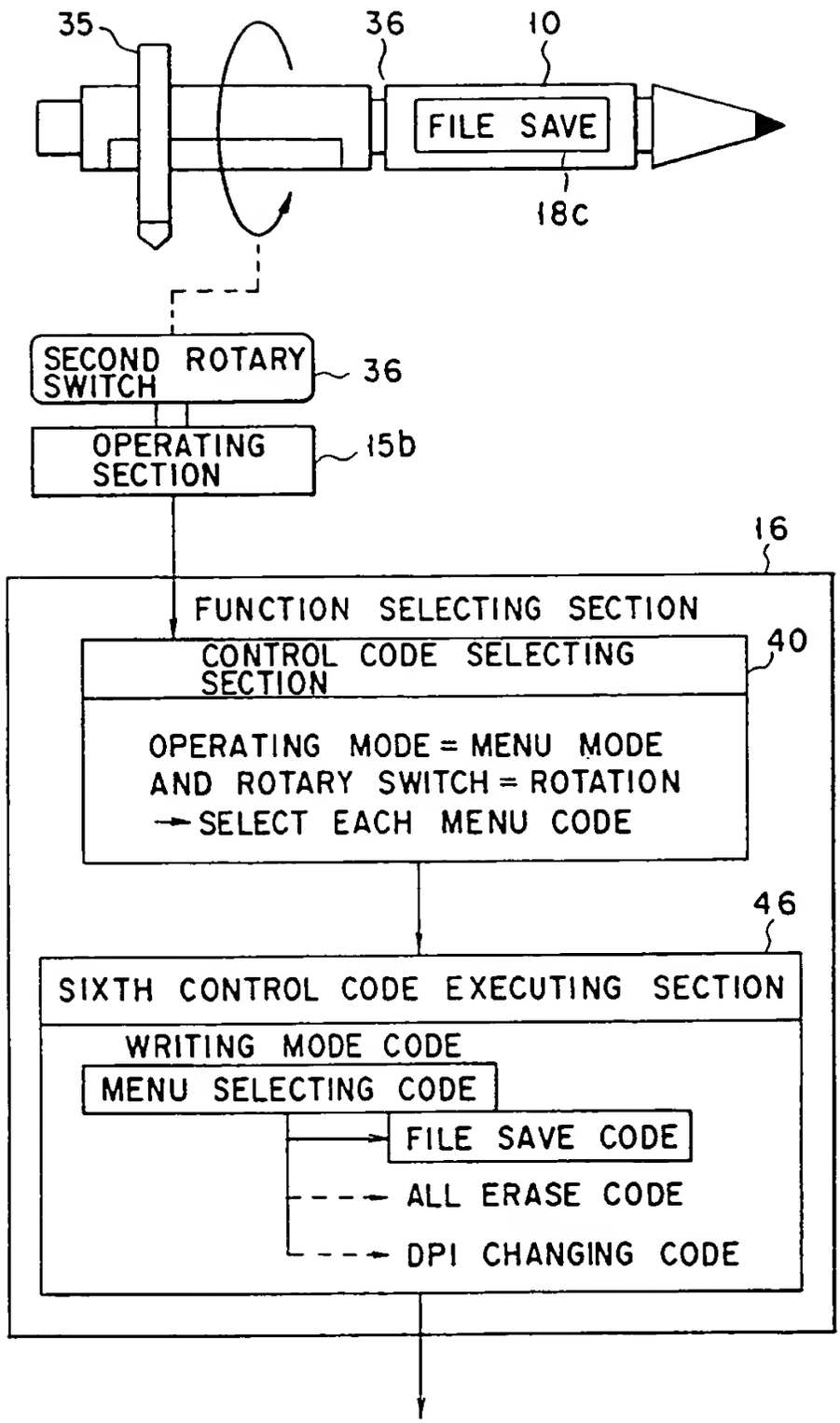


FIG. 28

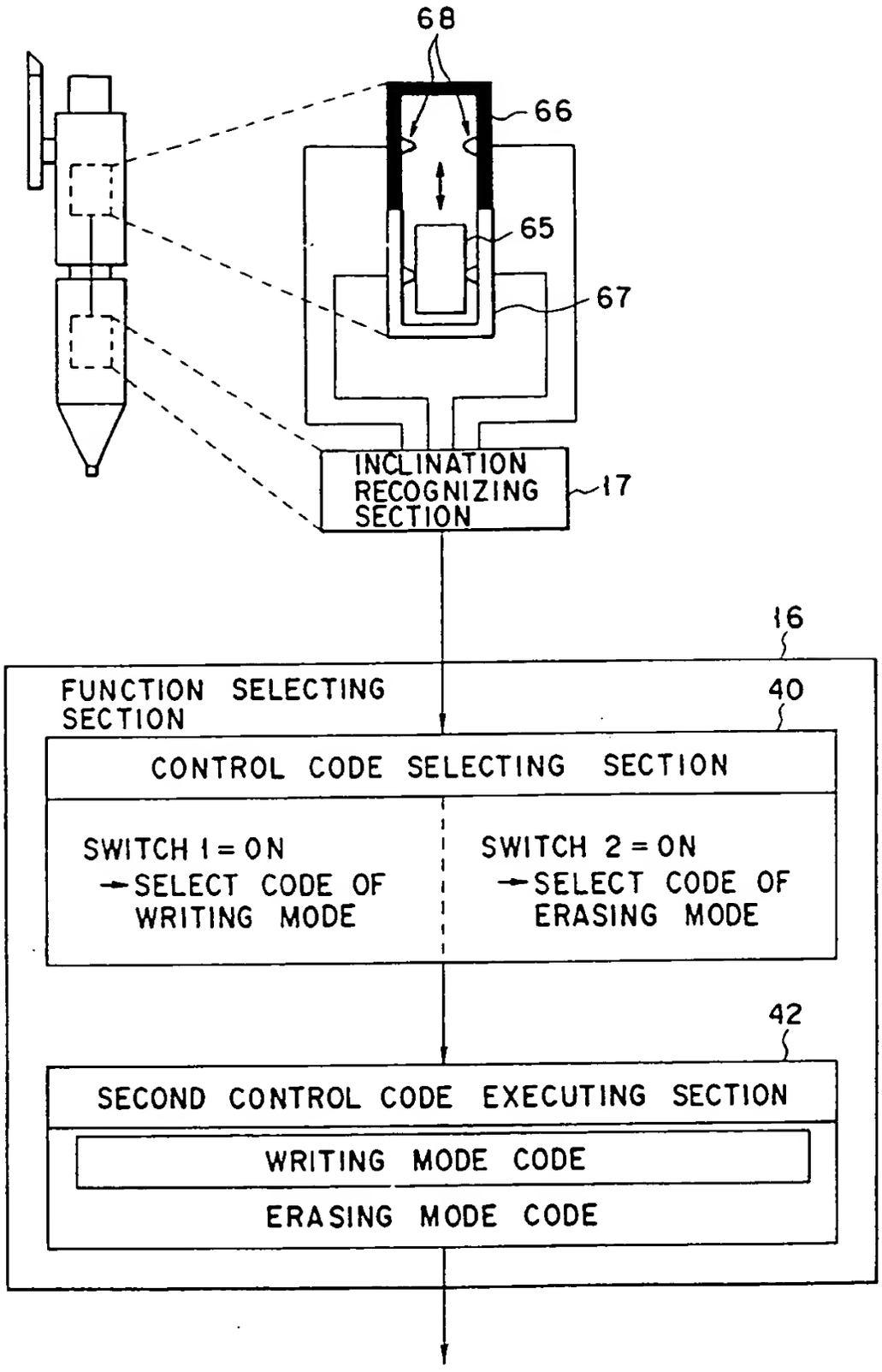


FIG. 30

(ADRS , TIME)----WRITING INFORMATION CODE (−1 , −1)----END CODE OF ONE STROKE WRITING ETC. (−2 , −2)----WRITING SUBJECT CHANGING CODE (−3 , −3)----WRITING INFORMATION CODE OF ERASING AREA

FIG. 32

WRITING SUBJECT CODE	(−2 , −2) (LINE WIDTH : 3) (LINE DENSITY CODE : COLOR CODE , DITHER CODE) (−1 , −1)
WRITE INFORMATION CODE	(2 1 , 0 0 0 0) (2 0 , 0 0 0 1) ⋮ (−1 , −1) (1 0 , 0 0 2 3) ⋮
WRITING INFORMATION CODE OF ERASING AREA	(−3 , −3) (2 5 , 0 1 4 5) (2 6 , 0 1 4 7) (5 9 , 0 1 5 0) ⋮ (−1 , −1) ← END CODE OF ERASING AREA
⋮	⋮

FIG. 33

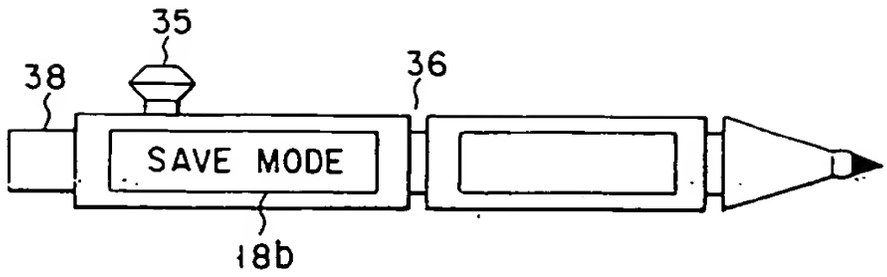


FIG. 35A

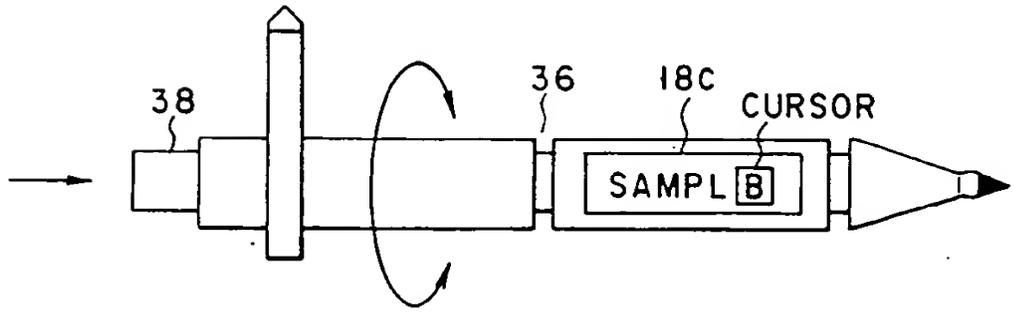


FIG. 35B

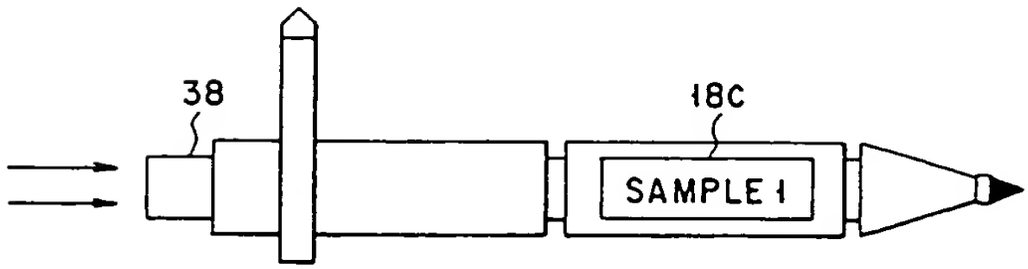


FIG. 35C

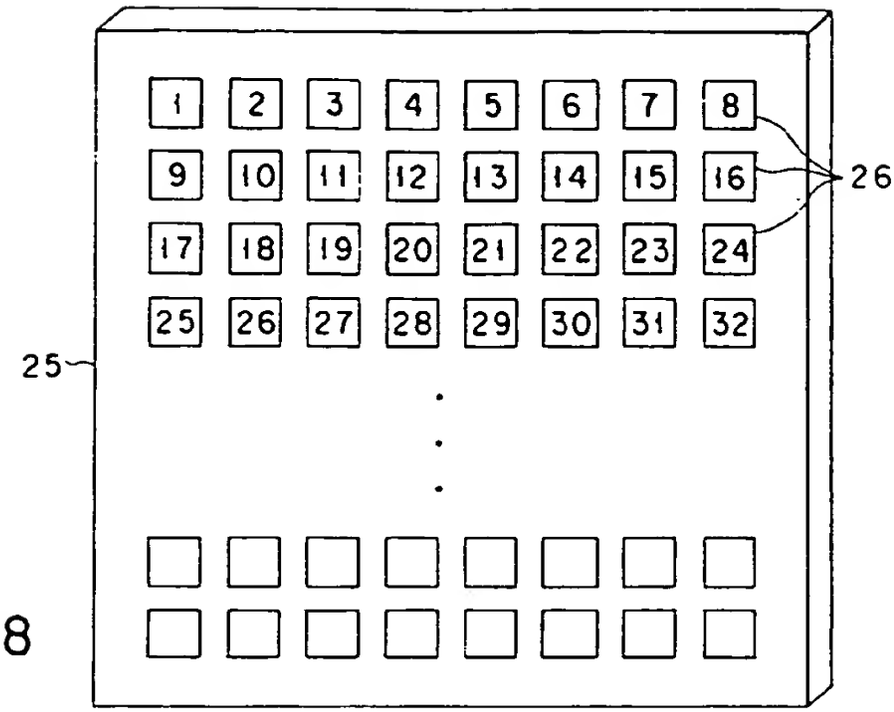


FIG. 38

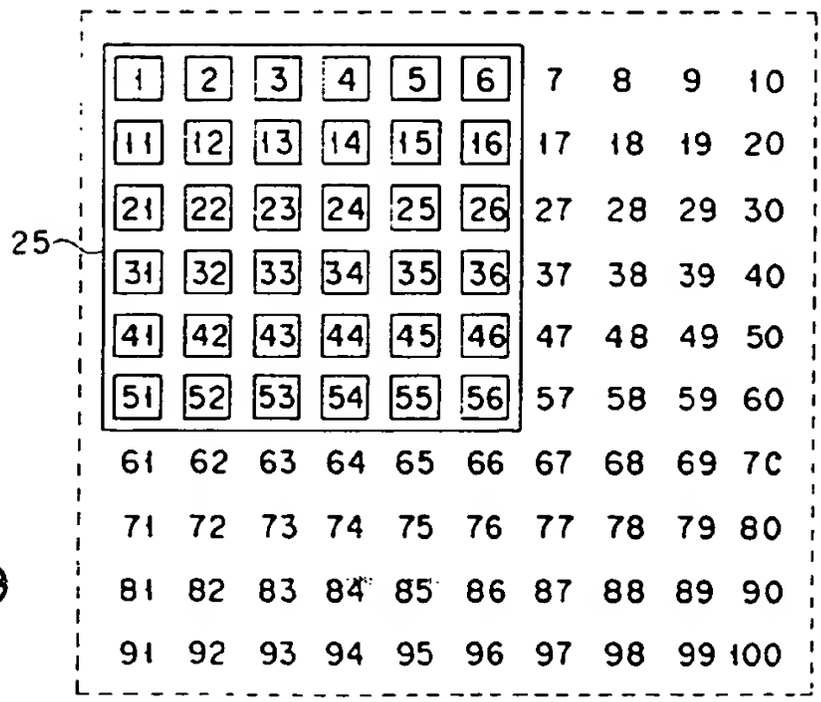


FIG. 39

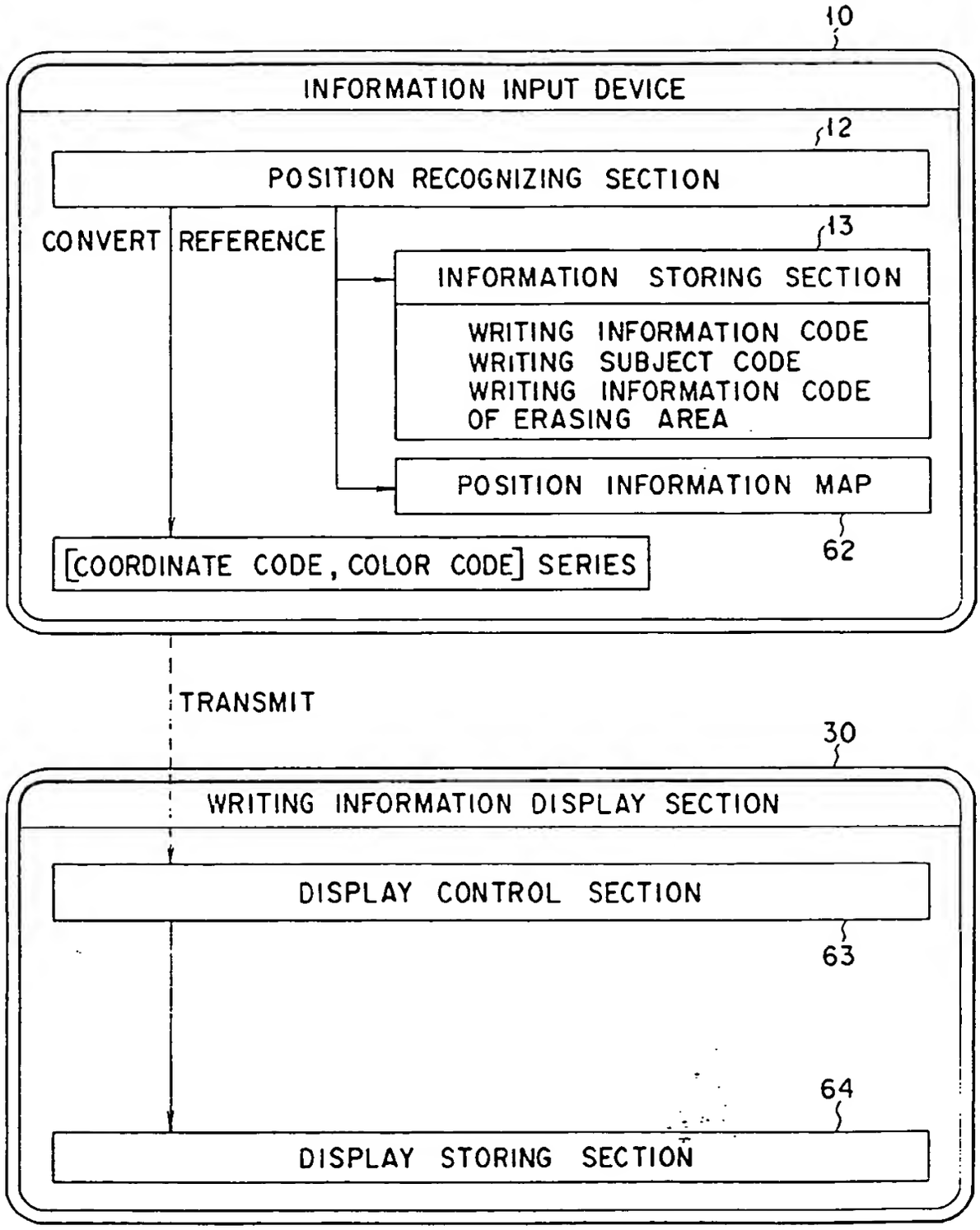


FIG. 41

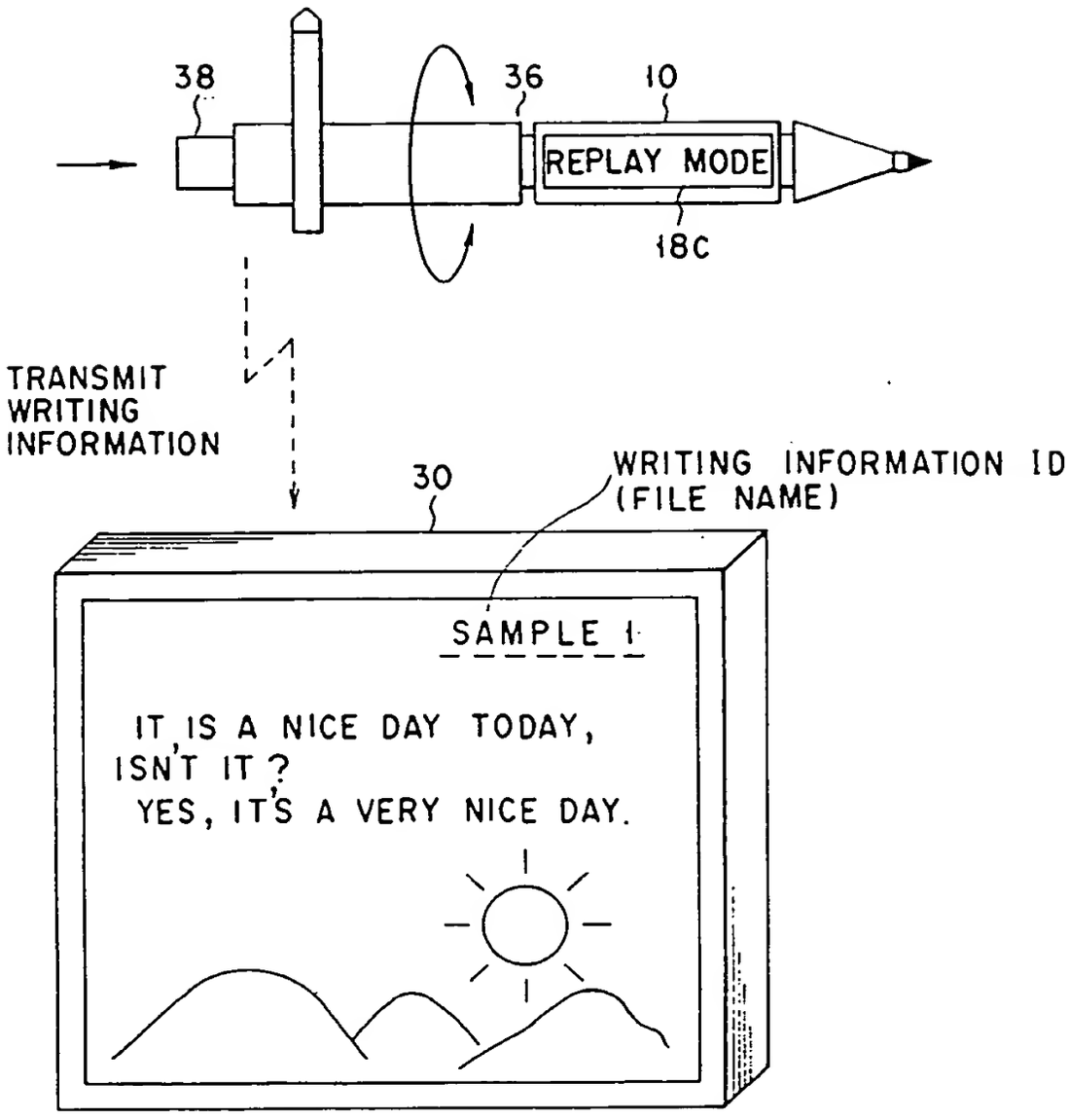


FIG. 43

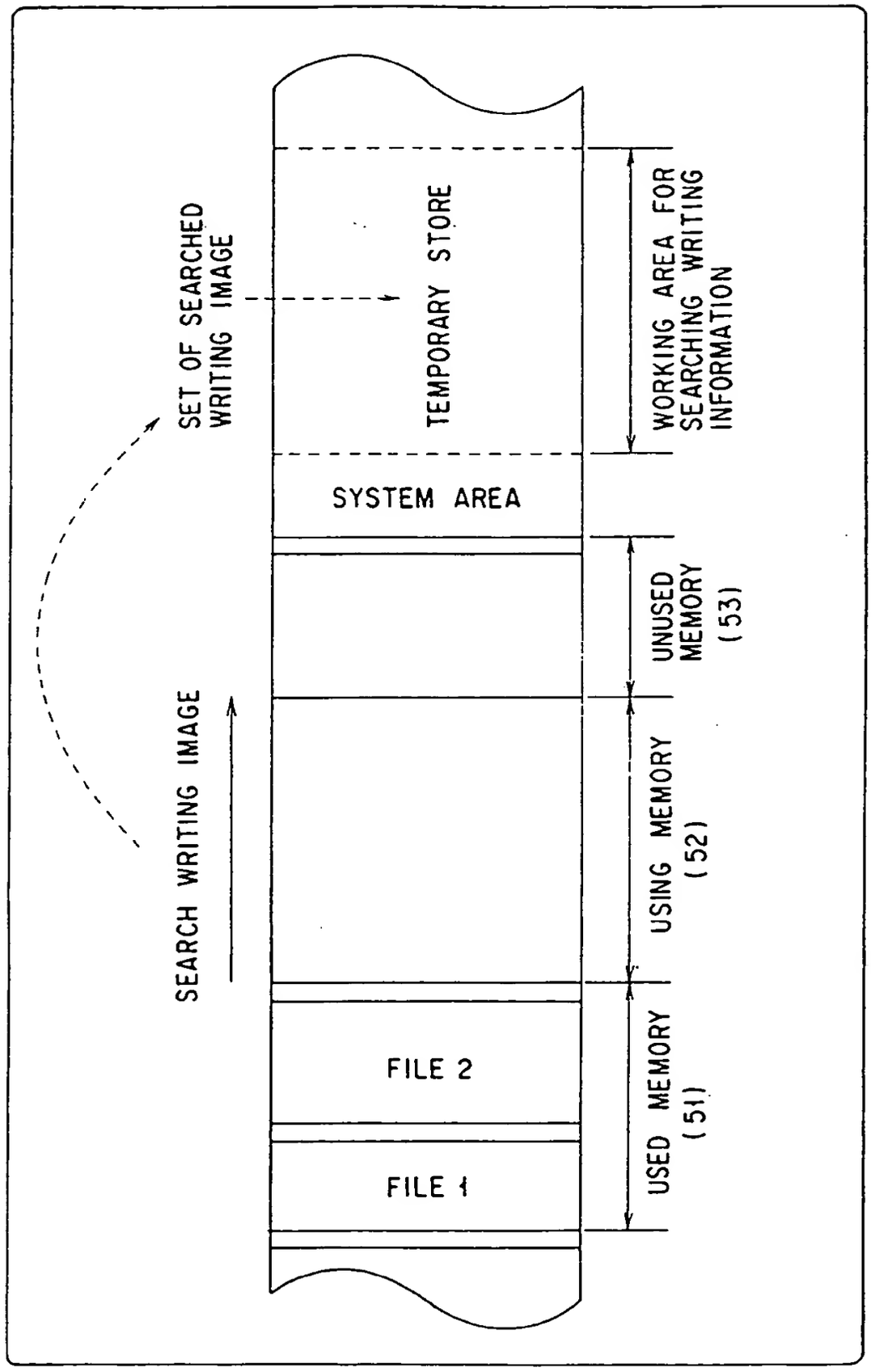


FIG. 44C

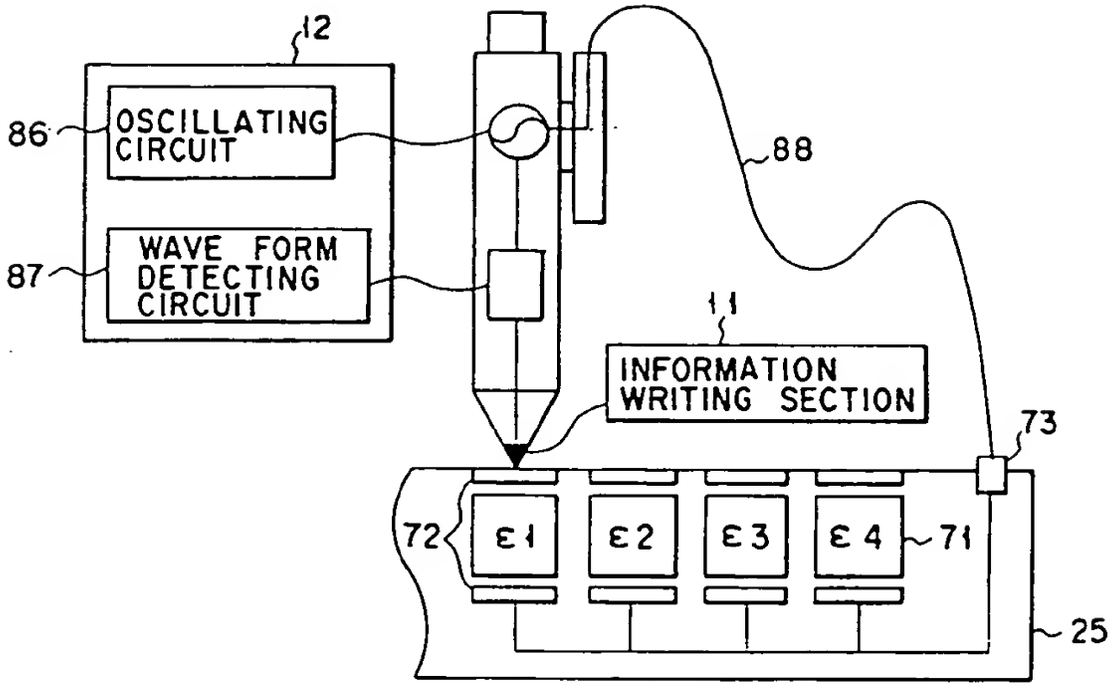


FIG. 47

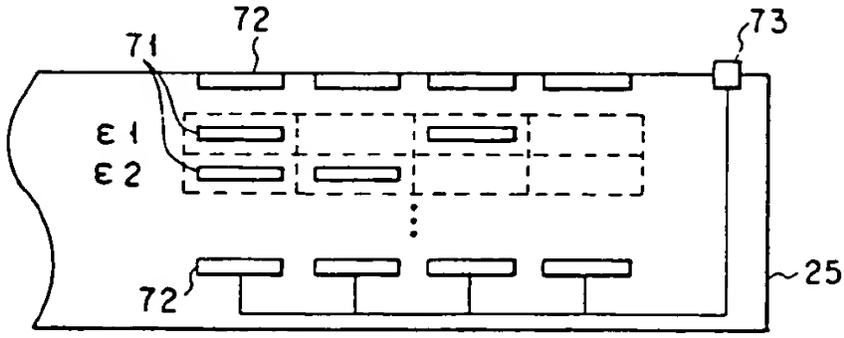


FIG. 48

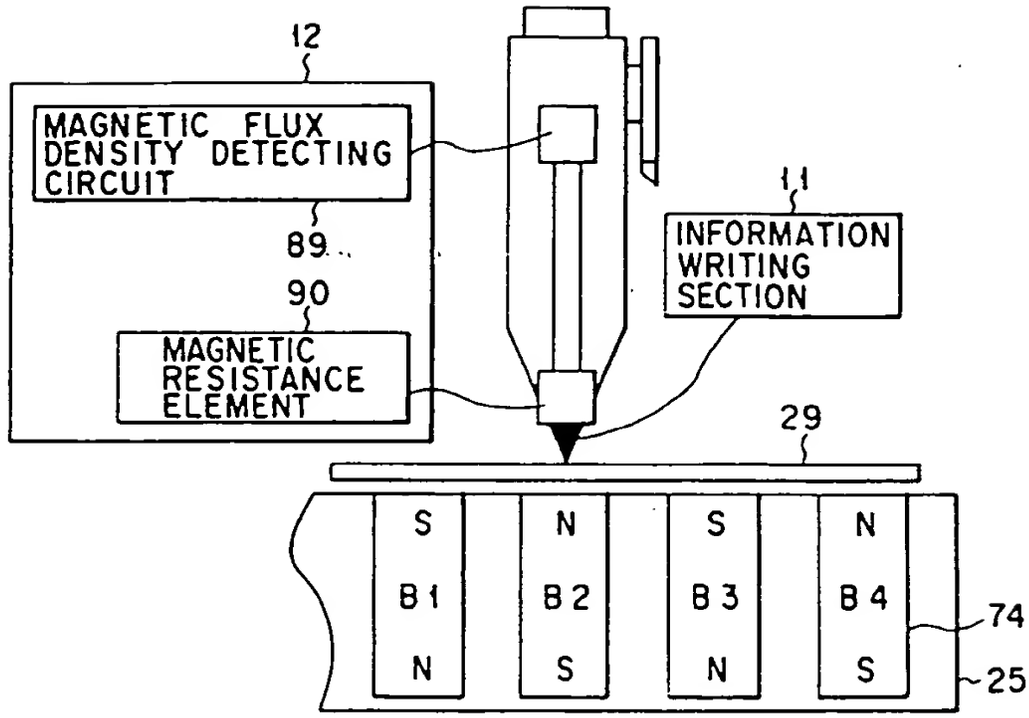


FIG. 50A

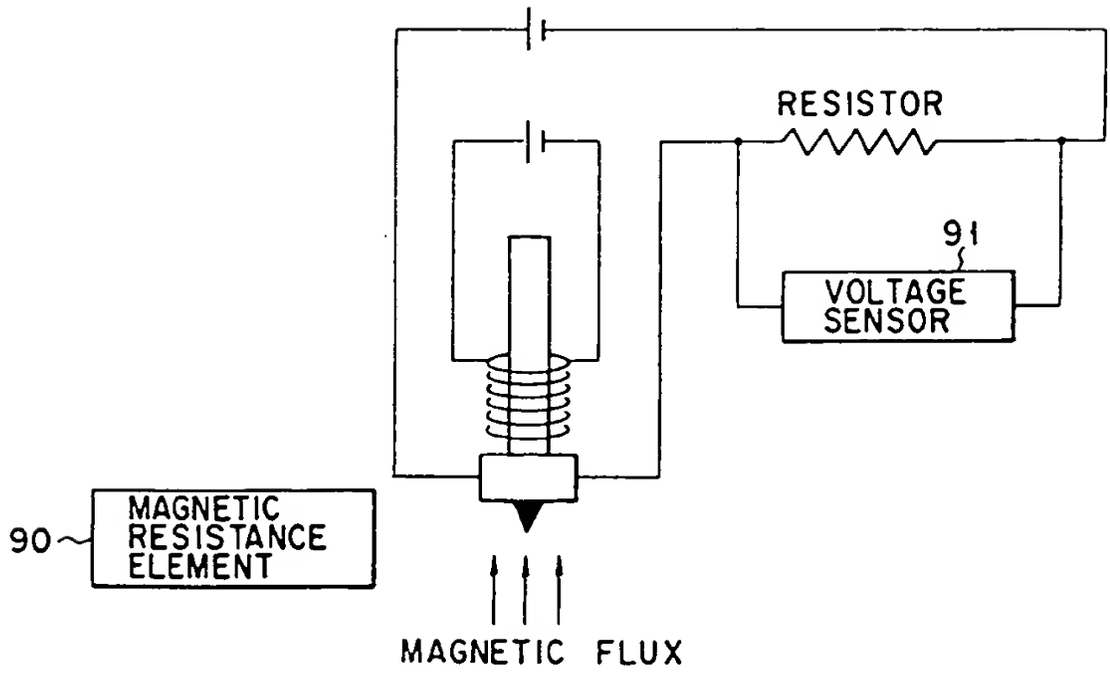


FIG. 50B

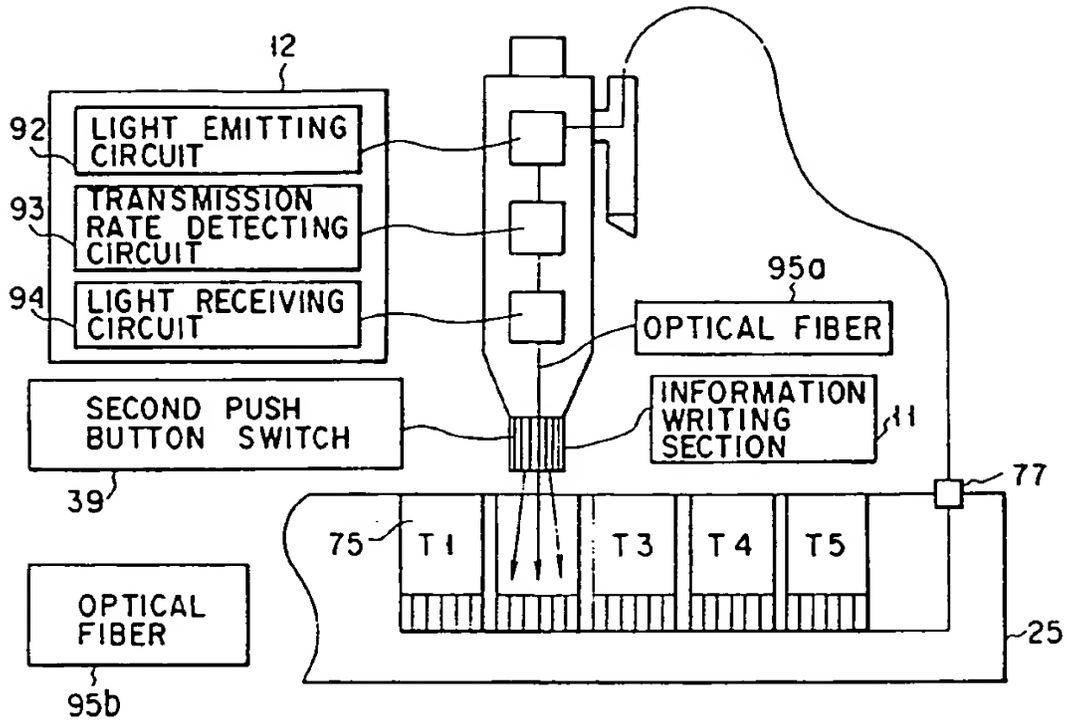


FIG. 52A

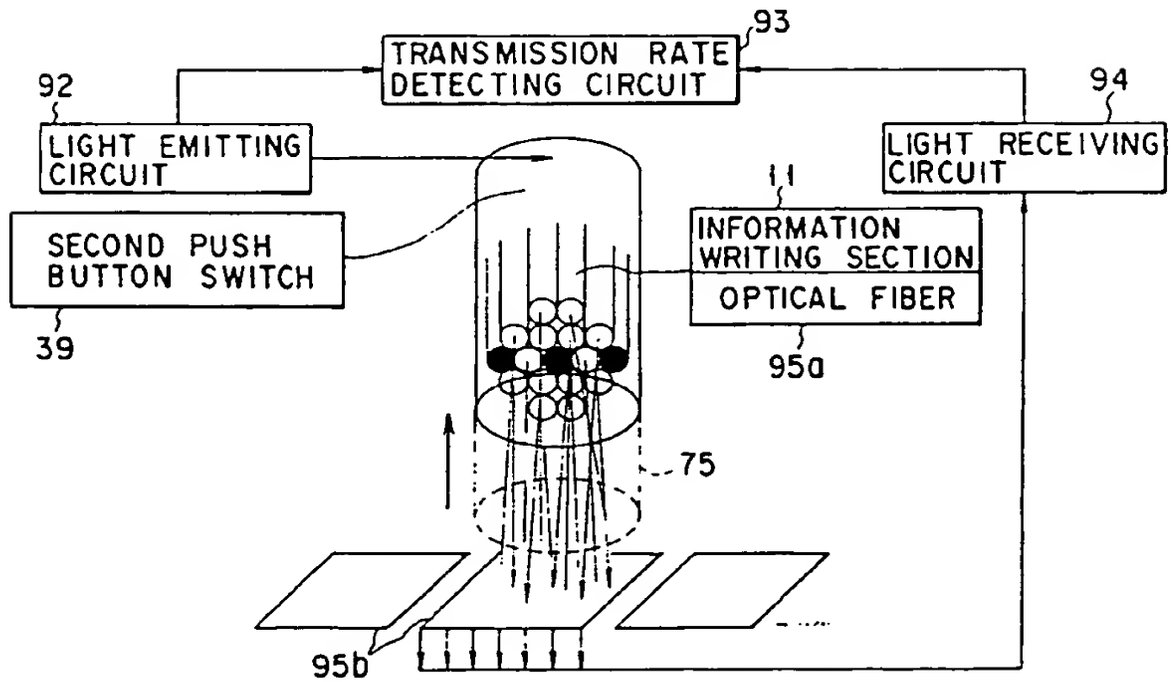


FIG. 52B

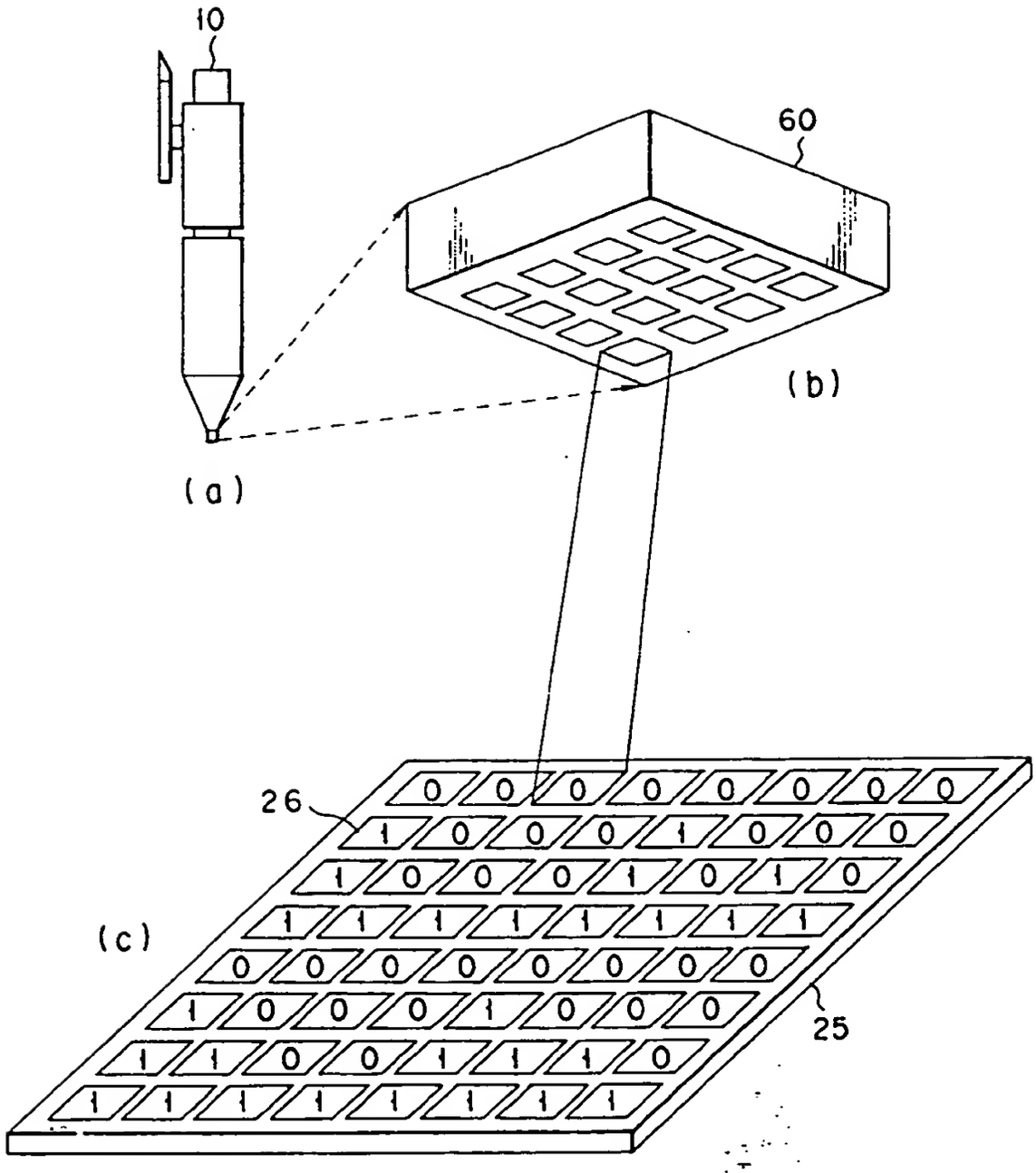


FIG. 54

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

FIG. 56A

1.1	2.1	3.1	4.1	5.1
1.2	2.2	3.2	4.2	5.2
1.3	2.3	3.3	4.3	5.3
1.4	2.4	3.4	4.4	5.4
1.5	2.5	3.5	4.5	5.5

FIG. 56B

1	2	3	4	5
6	7	8		
11	12	13		
				14

FIG. 56C

1	2	3	4	5
2	1	5	4	3
3	5	1	1	3
4	2	2	4	4
5	3	3	2	1

FIG. 56D